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VETERINARY MEDICINE

APRIL 1938

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The first dog food manufacturer to advertise the approval of the American Animal Hospital Association has published its announcement. It lists its product in Wichita, Kans., 200 miles from where it is manufactured, at $1.60 per case. The freight is 17 cents, cost of cans 74 cents, carton 7 cents, labels 6 cents, brokerage 8 cents, manufacturing (not including cost of materials) and selling 22½ cents. This leaves 25½ cents, or just over ½ cent per can, allowable for the manufacturer's profit and for what goes *into the can!* The advertisement says: "Give your pet a treat"—a half-cent treat. Possibly it is intended it shall be given something to eat afterward.

* * * *

The Mink Breeder's Association of the United States was organized in Chicago in March, 1937, with 53 members. It held its first annual meeting in Elgin, Ill., last December. At that time, it had 310 members (an increase of nearly 500%) and included the producers of over 75% of the ranch raised mink in this country. Forty-four exhibitors from 13 states showed 353 live mink at the show held in connection with the annual meeting. A mink style show participated in by movie and radio stars and many others was held on two evenings during the meeting. Three newsreel companies photographed the style show.

Dochez and Stanetz, Columbia University, report the successful treatment of 18 cats suffering from cat distemper, naturally acquired, and the recovery of 26 of 28 dogs treated in various stages of canine distemper. The drug used was sulfanilyl sulfanilate, one gram per kilogram of body weight. In this dosage the drug produces no intoxication or other untoward effects when given over a period of two weeks. It is completely excreted within 24 hours. When given to dogs and ferrets during the incubation period after inoculation with distemper virus, the disease did not develop.

* * * *

Conservative to the core, the veterinary profession has almost resented new avenues of employment. Swine practice, small animal practice, poultry practice, food inspection, all were forced upon it by agencies outside the profession. In default of professional leadership, laymen have guided the profession since the days when equine practice was supreme. Without expert leadership many things have gone awry. A veterinarian needs to be disguised as a milk sanitarian to inspect milk and the cow that produces it, as a government expert to visit a local abattoir, as a comparative pathologist for research. About the most effective corrective offered by organized veterinary medicine so far is to bawl about it.

Fifty Years of Professional Work

The fiftieth anniversary of L. A. Merillat's graduation celebrated at the Ontario Veterinary College at Guelph and Toronto in January recalls some of his activities in organized veterinary medicine and other fields during a half century of professional life. He was one of the three founders of the McKillip Veterinary College (1892) and of the Chicago Veterinary Society (1896). He served as the secretary of the former and was one of the early presidents of the latter and is a past president and past secretary of both the American and the Illinois Veterinary Medical Associations. The latter he served as secretary for many years and was honored with the presidency as the World War was coming to an end. In recognition of service with troops in action on the Western Front he was made foreign correspondent of the *Académie de Médicine Vétérinaire de France* and received the decoration of *Chevalier de la Legion d'Honneur* of the Republic of France. For the past 10 years he has represented his own district (Wisconsin, Indiana and Illinois) as a member of the Executive Board on the national association. For an equal period he has been president of the Illinois board of veterinary examiners.

But, to him, these are only mortal tributes; only immortal work counts for much in the biography of a man and, needless to say, often these in our profession are little known because following closely the events of history has not been a habit in the American veterinary circle. Instead of strutting over these man-made decorations, Merillat prefers to be known by such work as inspiring wealthy M. H. McKillip to found the first of our three-year, proprietary veterinary colleges—one that would stand out from the two-year patterns of that day and possibly induce the others to follow the example for the betterment of the faulty educational system that had been too long neglected for the general good.

Then we have heard him point with pride to the passing of the Illinois Veterinary Practice Act (1899) after ten years of bitter fighting in the state legislature against the organized opposition of non-graduate practitioners who, for years, had been able to marshal the agricultural-minded law makers to their support. By mobilizing the forces of the newly-organized Chicago Veterinary Society, the Illinois State association, the two colleges in Chicago and the non-graduate veterinary organizations, the legislature passed the Veterinary Practice Act believing that the Governor (Tanner) would veto it. But it was not vetoed. State Veterinarian Lovejoy, a broad-minded non-graduate, attended to that detail and thus won the profound admiration of the whole profession in addition to removing the stormy protests which had followed his appointment. The achievement may be attributed to excellent diplomacy and leadership.

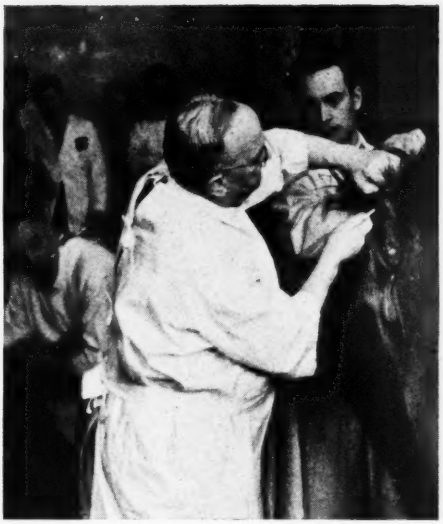
Everyone likes to be a friend of everyone else. Few ever boast of the enemies they make. Merillat agrees that he was not popular among the owners of the private veterinary schools, not even in the schools in which he taught. In the inner circle of these schools he argued for higher requirements; they for better balance sheets. It was over a debate about going backward to a two-year course that he left the McKillip Veterinary College in a huff (1900) and joined the faculty of the Chicago Veterinary College which had just joined the three-year group. It would have been a severe blow to the march of veterinary education had a college starting out in the three-year class conceded that the plan had failed. After eight years in the three-year class students were not flocking in as expected. Merillat's joining the Chicago faculty along with his brother and Wright, also of the McKillip faculty, prevented a leading school from dragging the none-too-good educational system in the wrong direction. Nothing had occurred up to that time to convince the veterinary profession that the state schools of that day would be able to pry sufficient appropriations from their respective state legislatures to furnish an adequate person-

nel for the growing veterinary service, private and public.

Fourteen years later, for communing with the advocates of higher requirements, he was branded as a traitor to the private school group who were denouncing the idea as unthinkable and financially impossible. The reality and bitterness of the fight is best told by his defeat for the secretaryship of the national association at the New York meeting (1913) where the private school forces led by Joseph Hughes, president of his own college, campaigned vigorously against his election on the ground that he was an enemy in the camp (the private school camp). This explains why in 1914 he quit teaching to devote all of his time to the firm of Wright & Merillat who enjoyed one of the most important veterinary clienteles ever developed in this country. He was, however, elected secretary of the national association at the Detroit (1916) meeting and again at Kansas City (1917), but, a few months later, turned the office over to an acting secretary (L. Enos Day) to enter the army which was then striving with considerable uncertainty to form a veterinary corps for the service at home and abroad.

Championed Section Work

In 1907, 1908, and 1909, he championed the idea of dividing the work of the national association into sections. Strange as it may seem, the idea was called crazy, preposterous, and was disapproved by the Executive Committee. Speaking in opposition to the section-work project, an influential member remarked, "How can a man be in two rooms at the same time?" That such a type of nescience could find advocates and keep an association from going forward, is hard to believe. However, the recommendation finally passed and as a consequence the San Francisco (1910) meeting was conducted in three sections, namely, General Sessions, Section on General Practice, and Section on Surgery. Merillat was the first chairman of the latter and he now wonders on just what grounds it was abandoned inasmuch as surgery is a special branch of medicine with plenty of room for improvement and, commercially speaking, a productive source of income. Since San Francisco, however, other sections have been added even though clinical medicine was merged into but one section. Yet, the administrative officers of the association wonder why memberships are hard to "sell" to the clinicians.



L. A. Merillat demonstrates the cosmetic operation named caudal myotomy before the students.
***Place:*—Surgery of the Ontario Veterinary College, Guelph, Ontario.**
***Time:*—January 26, 1938.**
***Occasion:*—Fiftieth anniversary of his graduation.**

Obviously, "How can a man be in two rooms at the same time?" lacked the wisdom the national association needed. It was based upon the presumption that an association is conducted merely to edify those who happen to attend the meetings. That it was hard to overcome the spurious idea that entertaining the given audience is the main purpose in association work, is a curious paradox. The publication of papers and committee reports presented by competent specialists for the edification of all concerned in order to broaden and bring up to date all knowledge of medicine had not been seized upon as the cardinal function of organized veterinary medicine. Thus were born such journals as VETERINARY MEDICINE which made readers of practically all veterinarians in the country by telling what associations were doing and publishing the

papers read before them. Some years later (1915), the national association was driven to found a journal of its own—a step sorely needed many years before. Without leaders capable of breaking down the archaic notion that all of the work of an association meeting should be done in one room, the national association might still be wearing the swaddle of its infancy, or the tattered pants

Major L. A. Merillat in 1917

of the gamin. Conservatism does just such things.

Establishes Small Animal Section

Objections to covering the entire field of veterinary medicine lived on, so Merillat, while president (1924-1925) had to found a small animal section arbitrarily. With the aid of J. C. Flynn of Kansas City and his coworkers, although disapproved by the Executive Board, he supported the organization of such a section for the meeting at which he presided (Portland, Ore., 1925). Prominent figures in the association's council denounced the step as illegal. But that did not silence the gavel of a determined officer with the will to act and to take the consequences of the *fait accompli*. As everyone knows, the small animal section was a success from the start and it became not only a legal division of the national association but one that was soon to draw the biggest audiences.

Why a group of clinicians as devoted to an exclusive specialty as outstanding as small animal medicine, then growing by leaps and bounds, had to force itself upon the national association instead of having been solicited to form a section of its own, needs no explanation to those who know the difference between regressive and aggressive action in association work. As everyone knows Merillat is not a conservative. To him, serene conservatisms spells impotence. The aggressive, often called radical, goes forward and prepares the ground for the conservatives to exploit when it no longer requires courage to do so. In this fashion, the radical having no selfish interest accomplishes his purpose. Such has been Merillat's philosophy and what he has done was not accomplished by fanfare in open meetings nor by arguments before committees. Keeping in mind that the membership is the court of last resort, he merely has to ask his friends to vote right on important issues.

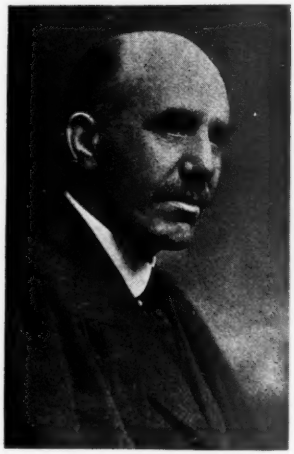
As a Veterinary Officer

Except as he wrote it in Veterinary Military History of the United States, silence characterizes his attitude toward his military service, although organizing and commanding the veterinary service of the First Army during its advances against terrific enemy resistance (1918) was a brilliant piece of work considering the obstacles which had to be overcome and the prestige that had to be built up for a corps that was little understood by the front line commanders. The difference in the miserable condition of the American animals during the winter of 1917-1918 when there was no veterinary corps and their "horse-show" condition the following winter in the same territory after many weeks of battlefield exposure when a veterinary corps was operating, is singled out as a notable achievement, but of no greater importance than the

fact that when the A.E.F. University was founded, a veterinary division was installed, showing that officers, who had had no more standing than a lance corporal the year before, had won a place in the hearts of the expedition. These two facts of record speak for themselves, and to him they are more significant than rank, promotions and decorations.

As a Teacher

In college work, Merillat never claimed to be a professor in the generally accepted



Charles D. McGilvray
Principal of the Ontario Veterinary College at which the 50th Anniversary of the graduation of L. A. Merillat was celebrated with speech-making, a banquet and a special clinic.

sense of the word, nor even a trained teacher. He merely possessed the knack of telling his personal experience in understandable language, and he never ventured beyond the bourne of his ken. One credits him with having been a pioneer in general anesthesia and asepsis. Articles on the latter subject by his pen were among the first to appear in American veterinary literature at a time when some of the foremost figures in his field—surgery—were dubbing asepsis in animals as an impractical hobby.

Merillat has been a prolific writer for more than four decades. He has doted on telling his colleagues everything he knew about clinical work, but would be the last to claim that his early books and articles were even passable from the literary point of view. They were written in haste "between colic cases" as he once remarked, and were intended more to facilitate teaching than to occupy a permanent place in the literature. Their distribution, however, has uniformly far exceeded in this country that of any other works on the same subjects. But, that experience has been an apt teacher, is evident in his endless file of contributions.

His present connection is with the Haver-Glover Laboratories where he is known as "Director of Publications." His work in the commercial field is too near to be appraised but if past performance may be taken as the criterion, it is reasonable to predict that he will leave evidence of having lived there.

Bighead in Sheep in South Africa

In VETERINARY MEDICINE, Volume 32, No. 12, 1937, page 563, I have noted a reference to bighead in sheep, and that at certain times of the year this disease is quite a menace to your small stock industry.

In the Union of South Africa bighead in sheep, caused by photosensitization, at times causes very heavy losses in sheep and goats with unpigmented skins. In the season of 1926-27, we lost over a half million head of small stock from this disease as a result of photosensitization and jaundice caused by the eating of wilted *Tribulus terrestris*, the so-called "devil's thorn". The disease makes its appearance during periods of irregular rainfall and very hot weather which results in extensive wilting of the plants.

We have also on many occasions had serious outbreaks of photosensitization accompanied by jaundice on grass pastures. All the information which we have collected points very definitely to the probability of Panicum grasses being the cause.

I am giving you this information in the hope that it may be of some assistance to you in the elucidation of the cause or causes of bighead in sheep in your country.

DOUW G. STEYN,
Onderstepoort Laboratories.
Onderstepoort, Union of South Africa.

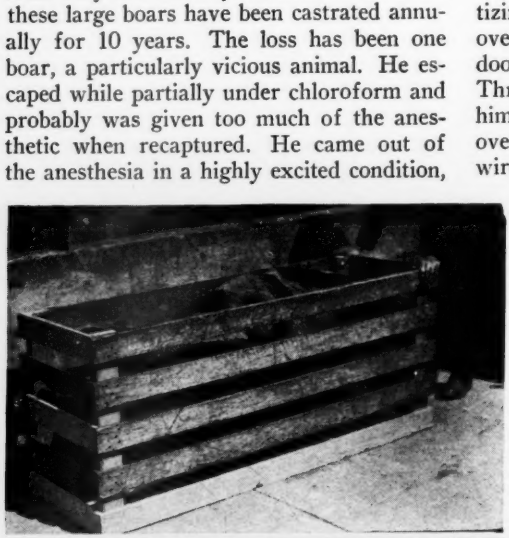
Castration of Large Boars Using Chloroform Anesthesia

By JOHN P. TURNER,
Washington, D. C.

THE accompanying illustrations show a method of castrating large boars, using chloroform anesthesia, that has been very satisfactory. From 20 to 30 of these large boars have been castrated annually for 10 years. The loss has been one boar, a particularly vicious animal. He escaped while partially under chloroform and probably was given too much of the anesthetic when recaptured. He came out of the anesthesia in a highly excited condition, tried to eat a cement wall, and was too dangerous to approach. He died in this delirious state.

The technique of securing and anesthetizing is as follows: The crate is thrown over the boar as he comes through a low door of the pen into the exercising yard. Three or four men hold it securely over him. One attendant passes a strong wire over the boar's shoulder and secures this wire to the lower slat on one side of the crate and then fastens the other end to a short stick, which is placed under the lower slat of the crate on the opposite side, using it as a fulcrum. This prevents the boar from jumping out of the crate.

The chloroform bag is made of leather, very similar to the feed bag used in the cavalry, and has a short canvas extension, around which is placed a rawhide draw string. Two leather straps are attached to the other end of the bag. The bag is drawn over the boar's mouth and nose, up to the eyes. A gauze napkin slightly dampened and containing one-half ounce of chloroform, is introduced into the bag, which is left open to insure plenty of air at the



Top: Crate used by the author.
Center: The chloroform muzzle.
Right: The author operating.

beginning of the anesthesia. When the boar ceases his first resistance to the chloroform, the end is partially closed and the anesthetic is pushed slowly, carefully watching the respiration.

The attendant holding the wire over the boar's shoulder usually gives the operator the signal that the boar is relaxing his pressure on the wire. Usually one ounce is sufficient to produce anesthesia. Some take less and others may require one-and-one-half ounces. The writer's experience is that the larger the boar, the quicker the anesthesia and the less the resistance. Boars weighing 400 pounds frequently require more chloroform than boars weighing 600 pounds. When relaxation occurs, which is frequently very sudden, the crate is removed and the boar rolls over on his side, unconscious. Ropes are secured to his hind legs, which are drawn forward and secured.

The scrotum is thoroughly scrubbed with a soapy antiseptic and then washed with alcohol. The incisions are long and low, to give proper drainage. This is the most important point in boar castration. The writer uses an ordinary convex castrating knife and a canine emasculator. The knife is sharpened after each operation, due to the grit and sand which exist in the creases of the scrotum and which it seems impossible to remove by washing. The openings are then heavily dusted with bismuth-porcine-iodide, and the boar released. A kick usually brings the boar into a comfortable sitting position, where he is left to wonder what it was all about, while another boar is being crated. If they are slow in coming out of the anesthesia, a little aqua ammonia dropped near their nostril hastens recovery.

The crate is made of three-inch by three-quarter inch oak slats. It is six feet long, two feet wide, and 30 inches high. All slats are fastened by screws to the upright supports and the ends by angle iron. The crate can be shortened for smaller boars by having two slots one foot from the end for the introduction of a partition. Using this crate saves time and prevents accidents and lessens the labor very much.

Chloroform anesthesia is not only humane but produces a quiet operation.

Diamond Furs

The newest addition to the Fur Industry is the chinchilla. The pelt promises to take its place as the most costly and luxuriant fur in the near future. A pair of these small 25-ounce animals is valued at $3,200.00. At one time this fur was not so uncommon. Up to 1899, 433,000 chinchilla skins were exported from Chile. Alarmed at the rapid depletion of so valuable a resource, not only Chile but Peru and Bolivia in 1918 placed a limited embargo on both hides and animals, forbidding their exportation.

Various attempts to domesticate this animal have been made but it was the late M. F. Chapman, a mining engineer of Inglewood, California, who first accomplished this seemingly impossible feat. The problem of obtaining a very elusive animal, living naturally at an elevation of 11,000 to 18,000 feet in the high Andes and accustomed to a rarefied atmosphere, of nocturnal feeding habits, remaining among the crevices of the rocks during the daylight was indeed a serious one. To add to the difficulty native hunters and foxes, recently introduced from Europe, had depleted the number of chinchillas in their native habitat to near the vanishing point.

Nevertheless Chapman, in 1919, securing special governmental permission and with the aid of 23 native trappers working persistently finally succeeded in capturing his allotted seven males and four females. Then began his task of transporting them. This was accomplished by airplane.

The industry has since spread, not only throughout various sections of the United States but also to Norway and Germany. States in which farms are now located are: California, Utah, Idaho, Wyoming, Oregon, Wisconsin, and New York; all began with stock secured from the original importer. In case any veterinarian should like to visit the farm nearest him the following locations are given: South American Chinchilla Farm, Inglewood, California; R. E. Hughes, Idaho Falls, Idaho; Professor Peterson, Canyon Road, Logan, Utah; E. M. Barrus, Afton, Wyoming; and W. T. Burns, 83 Klink Road, Brighton, Rochester, New York.

It should be very interesting to any veterinarian to study the progress of this little ball of fur as it promises to become a very important part of the fur industry. The value and popularity of this pelt is assured. Through cautious scientific experimentation the industry rests upon a very firm basis. Every individual is pedigreed, the ancestry of each being traceable back to the original stock brought from South America.

According to Dr. B. B. Coale, of the Los Angeles County Live Stock Department, the internal anatomy corresponds in general to that of the guinea pig. External appearance can be described only by accompanying illustration. It is distinctly not a rabbit. The chinchilla rabbit has probably been named after this individual because of the slight similarity in the color of the fur.

The fur is ethereally fine, soft as down, of a silvery gray color, and in a garment has a rippling, chameleon effect. It requires 120 to 140 pelts to make a coat. The cost of such a coat would range between $50,000 and $100,000. If all the chinchillas now in the United States were pelted it would be possible to make only eleven coats. Thus the building up of breeding stock must necessarily progress a few years yet before any are pelted.

Chinchillas are monogamous, of nocturnal feeding habits, herbivorous and reach maturity at one year. They are bred at approximately six months of age and will breed at any time of the year. The gestation period is 111 days and the average number of young per litter is two. Infrequently it is necessary to perform a cesarian section. In case of orphans, syrup and cream suffices as a diet. Mortality of young averages less than 15%. When young are born they possess fur, their eyes are open and they weigh 1¼ ounces. They are weaned at eight weeks. Females are bred again the same day that parturition occurs.

They are housed in large units of pens on the home ranch in California. Each pen is approximately 3 feet by 6 feet by 6 feet, possesses a wooden floor and is screened on all sides. In each pen there is a small box containing a runway to provide a place for him to hide while the interior of the box is being examined. The chinchilla enters his box from the top.

Feed consists principally of whole grains,

The South American chinchilla is not a rabbit.

alfalfa hay, fresh green vegetables, and walnuts every other day in the winter. Approximate food cost of each individual per year is $2.

The home ranch possesses a small well-equipped surgical treatment room. No infectious diseases have yet been encountered. Ailments that have caused some trouble, but no serious losses are slobbers, obstipation (very few cases), chronic glumerulo-nephritis, urolithiasis (noted in conjunction with slobbers), and gastroenteritis.

Recently a subcutaneous cyst was noted occurring in a few of these animals. One of these cysts was sent to the writer here at the College. Doctors Morrill and Whitlock, of the Pathology Department, after macroscopic and microscopic examination pronounced this cyst a *Multiceps serialis*, of *Taenia serialis*. This can be remedied in all probability by the treatment of any dogs (carrying the adult parasite) upon the ranch with a suitable taeniafuge.

Fur farming is fast becoming an important field to the veterinarian. Mink, skunk, and fox farms have progressed rapidly in the last century and now the latest addition is the chinchilla which is slowly but surely assuming an important position. Any veterinarian will find a visit to any chinchilla farm near his locality entertaining and educational.

ANDY J. SARGENT, K.S.C. '38.
Manhattan, Kans.

The Micro-Relief Elements of the Digestive Tract in Domestic Mammals

By J. TEHVER, Dr. Med. Vet.,
Professor of Histology and Embryology of Domestic Animals, University of Tartu

MICRO-ANATOMICAL study is at present so closely connected with the sectional technique, that other forms of microscopical preparations, though they may prove more appropriate under certain circumstances, are neglected altogether. The text-books and manuals of micro-anatomy provide us with numerous examples of how attempts have been made to elucidate the three-dimensional forms of certain structures by two-dimensional illustrations imitative of microscopical sections. The fact is of particularly momentous bearing in the treatment of the relief of the digestive tract. Thus we do not find in Ellenberger's well-known manual and text-book of micro-anatomy a single illustration showing the relief of the digestive tract prepared otherwise than from a section. Yet the study of the elevation of structures is better carried out by the use of natural preparations divested only of their mucus and subjected to a certain degree of tension. The examination of such preparations or the study of the photomicrographs of these preparations will furnish us with a decidedly better conception of the matter than any verbal description together with deficient illustrations.

To rectify to some degree the possible deficiencies in our conception of the relief elements of the digestive tract, is the task of the photomicrographs reproduced in the present article. The verbal part of the article is not intended as a detailed description of the various relief forms; it treats the micro-structure of the surface of the digestive tract merely to the extent indispensable for the understanding of the illustrations.

The Tongue.—The tongue is covered with projections called papillae only on its dorsal surface. The papillae of the tongue are divided according to their form and purpose as follows:

1. *Mechanical papillae* are often described as filiform. As a matter of fact, this designation is applicable to mechanical papillae only in the horse and pig. In other animals they are of the shape of a needle, cone or claw. The mechanical papillae cover the whole of the dorsal surface of the tongue except in the horse and in ruminants. In these animals the back of the tongue is free of them.

2. *Gustatory papillae,* carrying taste buds in their surface epithelium. They include:

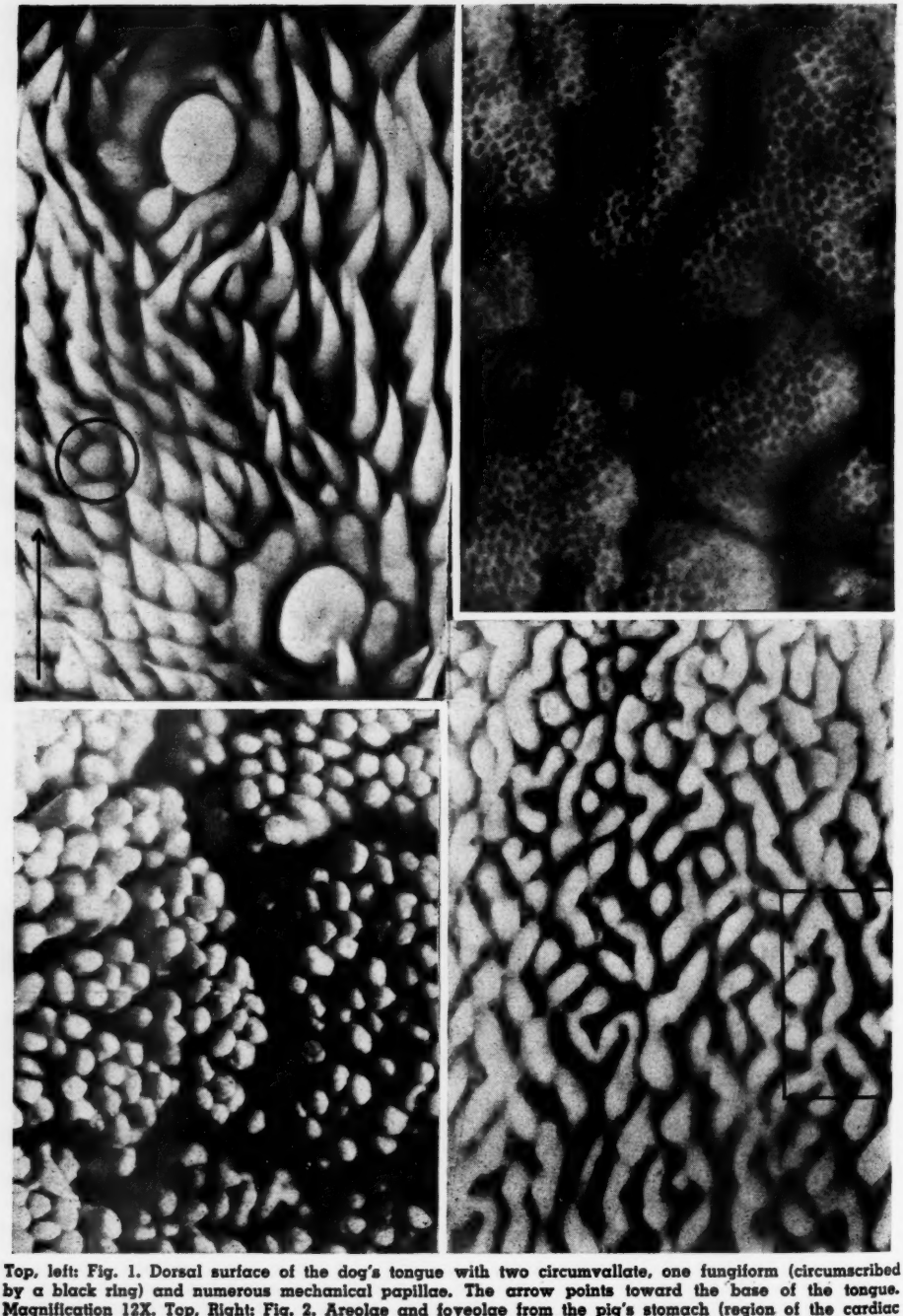
a. *fungiform papillae,* which, placed among the mechanical papillae, occur in large numbers on the whole dorsal surface of the tongue. They look round when viewed from above.

b. *circumvallate papillae,* which are situated between the body and the root of the tongue. Their number on a side is one in the horse and pig, two to three in carnivora and ten to twenty in ruminants.

c. *foliate papillae,* which are situated on the margins of the dorsal surface of the tongue anterior to the glosso-palatine arch. In domestic animals they are well developed only in the horse and pig.

The Stomach.—In the relief formation of the inner surface of the stomach and intestine may participate (1) the whole of the wall, or (2) the mucous membrane together with the submucous layer, or (3) the propria alone. The relief formations which result either through the participation of the whole of the wall, or merely through the accumulation of the submucous layer are macroscopic, and their number, size and shape are dependent to a large extent on the degree of the contraction of the organ. These macroscopic formations are not our present concern.

From the micro-relief point of view we are concerned in the glandular part of the stomach (pars intestinalis ventriculi) with (1) the small irregular regions called gastric areolae, which are surrounded by the



Top, left: Fig. 1. Dorsal surface of the dog's tongue with two circumvallate, one fungiform (circumscribed by a black ring) and numerous mechanical papillae. The arrow points toward the base of the tongue. Magnification 12X. Top, Right: Fig. 2. Areolae and foveolae from the pig's stomach (region of the cardiac glands). Magnification 35 X. Lower, left: Fig. 3. Finger-like villi from duodenum of a cat. Magnification 35 X. Lower, right: Fig. 4. Fold-like villi from the sheep's ileum. The openings of the propria glands are visible as black dotes between the folds. Magnification 35 X.

fissures intersecting the inner layer of the propria and which are most clearly perceptible in the fundic part of the organ and (2) with the tiny infundibular depressions, gastric foveolae, by which the gastric glands open on the inner surface of the stomach. The depth and breadth of the gastric foveolae vary in accordance with the region of the stomach and the degree of the contraction of its wall. In Fig. 2 we see them as darker dots of 1-2mm in diameter (their real diameter measures 50-100 microns). They are generally lower in the fundic region of the stomach, than in the region of pyloric glands. Their partitions, the interfoveolar septa, are comparatively narrow in the fundic region, but in the pyloric part they are rather thick and protrude between the slit-like foveolar depressions. The term gastric villi is sometimes applied to the pyloric interfoveolar septa because of their similarity to the intestinal projections. The differing shapes of the gastric villi and the interfoveolar septa do not correspond exactly to the extent of the fundic and pyloric glands and vary to a certain degree individually. The differing picture of the micro-relief of the stomach seems to depend to a great extent on the contraction of the organ. Thus, at least in the cat, it can be observed that the micro-relief of the pyloric region, when more strongly stretched, resembles the ordinary relief of the fundic region; the fold-like interfoveolar septa become flattened and the intervening deep fissures are replaced by the typical infundibular foveolae.

The Intestine.—From the micro-relief point of view the small intestine is easily distinguished from the large intestine, but not so their subdivisions.

The inner surface of the small intestine (from the pylorus to the ileocecal orifice) is covered with projections hardly perceptible to the naked eye; these lend to the inner surface of the mentioned organ a velvety appearance. For such a picture a mucus-free surface and fresh material are indispensable, for often a quarter of an hour is enough for the epithelium to become desquamated. The finger-like villi shown in Fig. 3 are characteristic of the whole of the small intestine of the dog, cat and horse, but in the domestic ruminants the fold-like villi prevail (Fig. 4).

Fig. 5. The inner surface of a sheep's cecum with numerous openings of propria glands. Magnification 35 X.

The villi are longest in the dog, measuring in the initial part of the small intestine in fixed preparations over 1mm; the horse and cat follow, whereas the height of the villi in ruminants and the pig varies from 300 to 400 microns.

Between the villi there are numerous openings of the propria glands or crypts of Lieberkühn. In Fig. 4 an attempt has been made to exhibit them also.

The last illustration (Fig. 5) presents the micro-relief of the large intestine. Owing to the disappearance of the villi, the openings of the crypts are distributed here uniformly. The appearance of the inner surface of the large intestine is comparatively monotonous, no essential variations, brought about by individual or by specific differences, having occurred, and it continues so all the way to the anus.

An Experience with Prontosil*

By V. BERWYN JONES, M.R.C.V.S.,
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THE subject was a four-year-old thoroughbred racehorse, a steeplechaser. The animal was well grown but in rather poor condition after two months at grass. The hot summer with dry herbage and excess of flies has not allowed any thin-skinned animals to do very well this year, unless they were brought in under cover and fed during the day. This gelding was kicked on the lateral surface of the near ulna in early May this year and was hopping lame for about a week, with a local swelling approximately the size of half a tangerine. The skin was just broken (about half an inch) and there was a thin, sero-purulent discharge. After three weeks of fomentations, etc., two spicules of sequestered bone were expressed. The wound then healed, and the animal went sound, although some tenderness remained. When at grass a few beads of serous discharge were observed occasionally. Towards the end of August the horse was brought up from grass and, after treatment for a strongyle infestation, was put into work. At this time the wound was completely healed, the animal was improving in condition and going sound and freely; in fact, it was doing half-speed work when the owner was called away.

In addition to the normal ration the gelding was given four ounces linseed oil daily, with about five pounds cut grass at 8:00 p. m. There is no doubt that during the absence of supervision this oil dose was omitted and perhaps the grass ration increased, a very bad attack of impaction and tympanites resulting. This was successfully treated by giving, by the stomach tube, four ounces of sodium chloride, six ounces sodium bicarbonate, one ounce chlorodyne, one pint oil of linseed and 30 grains hydrargyrum subchloride. However, during the very severe spasms he hurled himself down in the box, beating his head on the ground a number of times in frenzies of acute pain. Within two hours of the tubing, he was normal.

Twenty-four hours later the near elbow joint suddenly swelled; the respirations were hurried, the pulse 50 and the temperature 103°F. It appeared that generalized septicemia was imminent; the bowels were open and the movements free but not yet formed. After the lapse of a further period of three hours the case appeared to be *in extremis*. In spite of lancing, fomentations and syringing the wound—which only gave a few drops of clear serous discharge—the swelling descended nearly to the knee, had covered the brisket, depending like a half-melon, and, above, was nearly level with the point of the shoulder. The animal would neither eat nor drink and could not be moved except when lifted over in the box, when it would pivot on the hind legs, both fore legs being fixed to the ground in a manner reminiscent of an acute laminitis case.

AT THIS point 125cc prontosil was given intravenously. (Prontosil, the new drug that has been generally accepted by our sister profession as approaching specificity in their puerperal fever cases, has received only scant notice in veterinary literature. It is described as the di-sodium salt of 4-sulphonamido-phenylazo-7-acetylamino-1-oxynaphthalene-3, 6 disulphonic acid in 5% solution). Ten minutes after the injection, rigors began in the muscles of the quarters and the masseters. These were so well-marked in the latter that they appeared during a spasm to be almost incredibly bulged, the normally flat cheeks assuming a football-like outline. The respirations were now 60, the pulse 60, the temperature 104.5°F., and the body and extremities were stone cold. Just before the initial rigors the head, which had been held dejectedly below the knees, was violently shaken as if water had been poured in an ear, and the off hind foot was lifted and shaken like that of a "foot-and-mouth" beast. Starting at half an hour after injection, the penis was drawn and urine was

* Jones, V. Berwyn, 1937. An Equine Case History; *Vet. Rec.*, 49:43, Oct. 23, 1937.

voided in dribbles and drips in an uncontrolled manner. The normal stance of urination was not adopted, nor was the neck extended as is usual. The penis remained drawn and flaccid and urination continued in this manner for about one hour. Except for the application of warm blankets and rugs and putting on cotton-wool bandages, no active treatment was adopted in order not to interfere with the observation of the effect of the drug. Soon after urination had commenced the animal took a little chilled water and chewed a few handfuls of hay; but it was nearly three hours before surface heat returned. At four hours the temperature had dropped to 102.4°F. and the horse was picking interestedly at a hay net with a brighter eye and pulse down to 25. Mashes and corn were still rejected.

Twelve hours later the appetite was fairly good; the animal was urinating and defecating normally, the temperature was 100°F., the pulse 40 and respirations were normal. It was walked round the yard and except for a little stiffness enjoyed the mild exercise.

Three hours later the swelling, which had now become more localized with sharp edges of demarcation about a hand-span around the wound, was probed with a director and about four ounces of a thin, creamy, orange-colored discharge given exit. A rubber drain was then inserted and sutured to the skin. Fomentations and syringing with eusol were continued.

NINE hours later respirations had increased to 36, the temperature had risen to 102.4°F., and the pulse was 45. The swelling was again enlarging and the gelding moved over only with great difficulty. Appetite was in abeyance. One hundred and twenty-five cc prontosil was again given intravenously. This time, instead of producing shock, it appeared to be of almost immediate benefit. Within 15 minutes the head was up and the eye fuller and brighter, and a mash was accepted and hay eaten with relish. The temperature was, however, up to 103.8°F.

No discharge had been noted since the drain was inserted.

After an interval of 12 hours (i.e., the next morning) the temperature was normal, as were the appetite and functions. The swelling extended below the knee, but was not so marked between the forearms. There was a clear synovial discharge and the drain was left *in situ*. Treatment was by fomentation only. The gelding was very stiff and had not voluntarily moved in the box for 24 hours. Twelve hours later (in the evening) the temperature was 102.4°F., the pulse 47, and there was a copious, clear, synovial discharge. The drain was removed and a green blister applied around the wound to promote local swelling and closure. In the evening of this day 125cc prontosil was given, there being no reaction. Eighteen hours later the temperature was 102.5°F. There was no discharge from the wound, from the lips of which necrotic muscular tissue was protruding. This was cut away, the wound enlarged, and some necrotic material together with a watery discharge containing inspissated pus, resembling small rice granules, evacuated. The leg was fomented several times daily. The appetite was good.

TWELVE hours later the horse was moving stiffly about the box; weight was being placed on the leg without apparent pain, the swelling was decreasing and the wound was dressed with B. I. P. P. Liquid paraffin was worked into the skin down to the heel. A very thin discharge still containing whitish granules, exuded when the leg was flexed on movement. The appetite was very good, the temperature 101°F., the pulse 40 and the respirations were normal.

From this day onwards, the case continued to progress favorably. One week later, although the wound had not completely healed, the animal was put to walking exercise, going level and freely.

* * * *

Horses with symptoms of general bone disease studied in an investigation by Errington showed no significant change in total calcium, but a significant decrease in the organic phosphorus concentration in the blood serum.

Recent Developments in Small Animal Practice*

By J. GILBERT HORNING,
Houston, Texas

In preparing this paper I have included certain material that gives the latest data on various subjects that affect our every day practice. Some are to stimulate our thought in cases that might be presented and others cover certain aspects that might have been passed over by those who are too busy to keep up on their reading.

The Author

Vitamins are a potent factor in the practice of medicine, being essentially those elements upon which the body depends for its normal growth and development. Much has been done by scientific research in presenting data about vitamins that help us in overcoming diseases and assisting in the promotion of health. Recent contributions on this concern vitamin C and vitamin G.

Vitamin C

Szent-Gyorgyi of the Hungarian University of Szeged discovered that a certain acid (ascorbic) in the adrenal glands of healthy men and animals had the same beneficial effects as vitamin C contained in oranges, lemons and tomatoes. He also demonstrated that paprika (a sweet pepper) was the best source of vitamin C. Further study of vitamin C in fruit juices and adrenals showed a permeability factor which he called vitamin P, not present in synthesized C. Vitamin P keeps the walls of body cells in good condition. Without C and P, pyorrhea and scurvy develop, the animal bleeds easily and has a lowered resistency to certain virus and bacterial diseases. With these vitamins such ailments are overcome. Contrary to the opinion of some that vitamin C is non-essential to the diet of a dog or cat, we include it in the diet recommended for these patients and believe it an essential factor for normal development and the maintenance of their health.

Nicotinic Acid or Vitamin G

This has created quite a furor in the medical profession as a pellagra preventive and has produced dramatic cures in very advanced cases where liver and yeast were ineffective. All primary work on the discovery of this product was done on dogs. It is of great value in the treatment of black tongue or any other type of vitamin G deficiency. It has also proved of value in anemias caused by parasitic as well as bacterial infections.

Viruses

We have heard of viruses for a long time but not until recently have we been able to get any conception of them. Dr. Wendel Stanley of the Rockefeller Institute Laboratory at Princeton demonstrated that a virus contains carbon, hydrogen, nitrogen and oxygen, like thousands of organic compounds. With the aid of the ultracentrifuge designed by Svedberg, he was able to measure the molecular weight of these macro-molecules; he instituted his work on diseased tobacco plants, and found that the virus of mosaic disease possessed the property of reproducing itself in great quantities when stimulated by contact with the living plant.

Dr. Ralph Wyckoff designed an air-driven centrifuge which serves not only to measure molecular weights but to form the first separation of the viruses. In work on animal viruses it was considered that if these could be revealed as protein molecules, the possibility of treating virus diseases by chemicals having a selective action on the molecules would be greatly enhanced. Dr. Joseph Beard isolated a virus from papillomas in rabbits which appeared to be a giant molecule weighing 20,000,000 units, which means that this virus is 20

*Presented at the annual meeting of the Texas Veterinary Medical Association, Houston, Jan. 12-13, 1938.

million times as heavy as a hydrogen atom. Dr. Carl Ten Broeck centrifugalized extracts of horse tissue diseased by encephalitis and obtained macro-molecules weighing 25,000,000 units. Finally it was learned that virus proteins may change so that they cause disease symptoms different from those expected. This suggests mutations—abrupt hereditary alterations—and demonstrates the wonderful progress these scientists have made.

Piroplasmosis

Up to the present time the most successful treatment for piroplasmosis in dogs has been rest under the most favorable conditions and good nourishing food. This disease can truly be called "the masquerader" as the symptoms vary so much and the diagnosis can be made only by a blood examination. The best procedure is the use of Wright's stain and the routine is to clean a new slide with acetic acid and then alcohol 95%. A thin smear of blood is placed on the slide and dried in the air; cover the slide with Wright's stain for 45 seconds, add about an equal quantity of distilled water, and allow to set for three minutes. Wash this off with distilled water, dry in air and examine. Some use Geisma's stain, but for the busy practitioner Wright's stain is recommended. This can be purchased from any veterinary supply house.

The latest treatment for piroplasmosis, besides the one mentioned above, is the use of acaprin (C.A.P. 3516). This drug is generally free from untoward effects. In toxic doses C.A.P. 3516 stimulates the sympathetic system and in still higher doses the central nervous system. In rabbits, intravenous injection of 2mg. of C.A.P. 3516 per kilo of body weight causes a drop in blood pressure and intestinal contractions. The uterus, however, is not affected. In cats, subcutaneous injection of 1mg. of C.A.P. 3516 per kilo of body weight causes salivation and contraction of the pupil; larger doses excite the central nervous system. The susceptibility of various animals to C.A.P. 3516 varies in the following order: 1. dogs, 2. horses, 3. cattle, 4. sheep, 5. pigs.

Therapeutic Considerations.—In fresh cases of piroplasmosis in the dog (canine babesiasis) C.A.P. 3516 has a therapeutic index of 1:32. Drugs hitherto used have had an index of only 1:8 in such cases. The babesiae disappear from the blood 24 hours after treatment.

Indications.—C.A.P. 3516 is particularly indicated in piroplasmosis caused by *Babesia bigemina, Babesiella berbera, B. columbiana,* etc., *Theileria dispar* and *T. annulata,* i.e., in practically all the piroplasmoses of cattle and in that of dogs.

Clinical Considerations.—In bovine piroplasmoses (*Babesia bigemina*—European piroplasmosis, Texas fever, Tristeza of Latin America and *Babesiella berbera*) the curative action of C.A.P. 3516 begins to be noticeable in a few hours, so that the urine clears up and the general condition quickly improves. The listlessness, dullness of the senses, and the cardiac and respiratory disturbances pass away. The appetite returns and the raised temperature falls to normal. A single injection usually effects a cure in 24 hours. In piroplasmosis of sheep, pigs and dogs the results of a single injection appear to be favorable, but the experiments are not yet complete.

Dose and Manner of Use.—C.A.P. 3516 is injected subcutaneously or intramuscularly. It is not suitable for intravenous injection.

The dose in the case of dogs is 1cc of a 10% dilution of the original solution for each 45 lbs. of weight.

Possible by-effects following administration are restlessness, tremors, recumbency, salivation and defecation. These symptoms are suitably treated by subcutaneous injection of suprarenin 1:1000 solution (3-10cc, according to size of animal and severity of reaction). The injection of C.A.P. 3516 may be repeated if necessary by an equal dose after an interval of 24 hours, but it must not be repeated after an interval of from 2 weeks to 3 months.

Tuberculosis in Dogs and Cats

Dogs and cats contract tuberculosis from both the human and the bovine type of tubercle bacilli. The dog manifests a strong resistance against the avian type. Fortu-

nately, since sanitary precautions are practiced in this country, there is only a small percentage of these animals that are found infected. In dogs the human type is found more frequently, while in cats the bovine type is more frequently seen. In the Horning & McKee clinic we have used the intradermal test in both the dog and cat and this should be given more consideration by practitioners. Tuberculosis in both dogs and cats is reported frequently in European veterinary publications and while the incidence of these diseases is undoubtedly less in this country than in Europe, particularly Continental Europe, it is by no means to be ruled out among our patients. If we looked for it oftener we should perhaps find it more frequently.

Chorea

Every practitioner is confronted many times a year by cases of chorea, wherein he is at times the initial examiner and at other times the second or third man to pass his opinion or advice on the patient. The following might be of benefit and should be kept in mind for cases where other treatment has been of no benefit, or as an initial treatment.

The administration of typhoid and paratyphoid vaccine to moderately severe and violent cases of chorea has proved of value in many instances. The initial dose is .05cc of undiluted vaccine administered intravenously, and tolerance to the vaccine increases with each day's treatment in most cases.

The treatment is given daily and stopped only when signs of chorea have disappeared. If this does not occur within eight days, a rest of four days should be given and a second series started. Therefore a dose that produces a satisfactory temperature of 105° F. one day may not on the following day. Hence there must be an increase in dosage in direct accord with the patient's reaction, should a second series be necessary, beginning with the same dose that was used with the last day of the first series. Good nourishing food and rest are necessary in conjunction with this treatment.

About Anthelmintics

The harmful results one sees in our every day practice due to the unintelligent administration of anthelmintics is appalling. Anthelmintic treatment should be carried out only after thought and study are given each individual case. Many factors enter into this, after macroscopic or microscopic demonstration of the worm or its eggs or larvae obtained in the feces, body tissues or fluids. One should know the parasites involved, their possible location and, after examination of the patient, the actual damage done by the infection and the general condition of the patient, so that one's judgment can be used in the choice of anthelmintics. This varies decidedly according to the physical condition, age and previous history of the animal. Many drugs are used under the name of anthelmintics. Some have a low and others a high toxicity to the patient and in some this depends entirely upon the condition of the animal. One should know not only the condition of the patient but also the anthelmintics used, their contraindications and possible toxic manifestations.

In the Horning & McKee clinic we always recommend a fecal examination and physical check-up prior to administration of worm medicine. By first checking up, I mean not only a physical examination of the patient, but also inquiry into the history of the animal so that all can be taken into consideration and the proper selection made of the anthelmintic needed and method of administration. It would be well to adopt this system as a universal practice by the profession. The worming of an animal is a vital matter and should be carried out by scientific men who will give it proper thought and study. We see cases every day brought to our clinic where the animals have been seriously damaged for life through the improper, careless and repeated worming and overdosing by ignorant persons.

It would be well to include in our new developments the education of the public on the serious aspect of promiscuous worming of dogs and the proper procedure to secure the best results.

Hippomanes—An Embryological Enigma

By JOSEPH GEORGE FEINBERG,
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Introduction

Recently in a state board examination, the question, "What is a hippomane?" was asked. That raises the question, "What *is* a hippomane?".

A man could complete a course in veterinary medicine without having the slightest idea of the answer to this seemingly simple state board question; unless he had used Smith's physiology[1] or Fleming's obstetric,[2] texts he might never have encountered the word anywhere in his studies. The standard medical dictionaries[0] do not define the word.

This surprising fact, together with the coincidental finding of a large hippomane in a mare's placenta at the veterinary clinic of the Kansas State College, led the author to investigate the subject. This investigation started out rather confidently with a routine search through the indexes of embryology and obstetric texts, but soon turned into a detailed perusal of numerous journals when text after text failed to reveal any mention of hippomanes. Finally, after much fruitless and a little fruitful search data were collected so diverse in both terminology and statements that the task of learning about hippomanes seemed more hopeless than ever. It is little wonder, when the confusion that exists upon this subject is considered, that as late as 1932 Beeman [3] says, referring to hippomanes, "Their origin and use are unknown."

One of the most confusing aspects of this study was the variety of terms applied to these masses found in the placentas of some animals, either attached to the membranes or floating free in the placental fluids.

"Hippomanes" is a term that has been applied to them for many centuries. Bernard [4] referred to them as "amniotic plaques"; while Pinoy[5] and his contemporaries called them "placental balls." Although there may be some doubt as to the identity of the objects described by these various authors, the terms mentioned will be used synonymously in this paper.

Another source of trouble in correlating the works of the several writers was the variation in terms applied to the different parts of the placenta and fetal membranes. To remedy this situation and bring order out of chaos, a uniform terminology will be used in that paper—that used by McEwen.[6]

Historical

Hippomanes first received recorded recognition in 1667 when W. Needham[7] wrote, "Spontaneous concretions I found also in later months; these I discovered in both places (allantoic and amniotic cavities). They are more frequent and larger, however, within the allantoic membrane." In 1806 Dzondi[7] also noted these bodies and again in 1828 they were described by Crépin.[7] For ages they have been used as aphrodisiacs and love-philtres.

Bernard discussed his "amniotic placques" in 1859. J. Needham [7] states that MacDonnell [8] confirmed Bernard's work in 1865, but in a careful reading of the latter's article no reference to these "amniotic plaques" could be found. Dastre[7], however, did discuss them in 1879.

In 1900 and 1901 a group of French workers—Pinoy,[5,9] Letulle,[10,11] Nattan-Larrier [12]—studied what they called "placental balls."

The best available description and discussion of hippomanes amongst modern writers is to be found in Jenkinson,[13] Fleming, McEwen, and J. Needham.

Occurrence and Description

Hippomanes were so-called because they are larger and more common in horses than in other domestic animals. The first half of the word is Greek for horse. However, it is quite probable that all the placentary bodies found in ungulates are similar to the hippomanes of the horse. J. Needham states inclusively that they occur in "mammals."

[0] Dunglison's Medical Lexicon (Edition of 1874) states that hippomane is derived from two Greek words meaning horse and madness, and says of the plural form it is "applied to a mare in the state of heat or rutting. Also the secretion from the vagina of a mare in that condition. Used of old, in the preparation of philters."—Ed.

In the horse, Fleming describes them as "small oval or discoid masses of a brownish color, from the size of a pea to that of a hen's egg. . . . Usually they have the consistency and elasticity of gluten, are flattened, and are thinner at the border than at the center" Jenkinson states that in the horse they are "large floating bodies often very hard." Beeman merely describes them as "certain peculiar masses."

In ungulates in general they have been described by Jenkinson as "curious rounded or elongated, often flattened bodies sometimes soft, sometimes hard and brittle."

Ruminant placentas in particular have frequently been observed to contain these peculiar bodies and in this case they appear, according to Fleming, as "laminated deposits like hippomanes, but smaller and lighter in color." Those in the cow were described by Dastre as "soft yet tough," while Jenkinson adds that "they are white or pale yellow" when free and floating in the fetal fluids, but before they break off and when "still soft, they are a bright orange color." In the sheep Jenkinson says they are a "dirty brown. . . . At first they are surrounded by a membrane—the remains of their covering of allantois and trophoblast—and are soft. . . . Later the membrane disappears, and the bodies become hard . . ."

Bernard's observations on the "amniotic plaques" were that they were 3-4 mm. in thickness, plate-like to filiform in shape, and often coalescing. At first they are transparent, later becoming opaque, especially towards the edges. When degeneration sets in they become yellowish due to fatty changes.

In the sow "small, white spherical bodies" may be found, according to Fleming; and Jenkinson claims that hippomanes are found in Sirenia.

Pinoy, using special fixatives and stains, noted "placental balls" in the placentas of guinea pigs. Shortly afterward Nattan-Larrier confirmed these findings and described the "balls" as "ranging in size from that of a nucleolus upward . . . attached . . . or floating free. In a later paper Pinoy states that the "placental balls" are variable both in number and in size, being numerous and small in young placentas and larger in those of more advanced age.

Letulle, employing the methods of Pinoy and Nattan-Larrier, also found "placental balls" to be present in human placentas, saying that he found "hyaline balls absolutely identical to those described in the placentas of guinea-pigs." Later he describes them as being "smaller at term (2.5—3 to 7.5—10 microns) than at the fifth and sixth month (10—17—37.5 microns) . . . The small ones are hyaline, the larger ones granular."

Bernard also found his "amniotic plaques" in the rabbit and guinea-pig, where they appeared as a "whitish substance" on the placenta.

Origin and Location

As to the matter of the origin and location of hippomanes, here recorded opinions and observations show great diversity. Common belief has long placed the hippomane in the mouth of the foal, but this is erroneous. In general, three locations may be ascribed to these placental bodies: allantoic, amniotic, and syncytiotrophodermic.

The true hippomane, if there is such a thing, is allantoic in location. In the allantoic cavity it is found either floating free in the fluid or attached to the allantois by a pedicle. Thus, Jenkinson found them in the allantoic cavities of the placentas of the cow, the sheep and the horse. Fleming reports them in the allantoic cavity in the horse and in ruminants, but places them just outside the cavity in sows—i.e., "between the chorion and allantois." Dzondi, McEwan, and Beeman also give the allantoic cavity as the site for hippomanes.

Nevertheless, though all agree as to the location of hippomanes, they are at variance about their origin. Beeman makes no attempt to solve the riddle of their origin, flatly stating that their origin is unknown. Jenkinson and McEwen ascribe the origin of hippomanes to an accumulation of uterine milk on the outside of the trophoblast, invaginating the latter into the allantoic cavity until a large ball is left attached by a pedicle, or breaking free entirely and floating in the allantoic fluid. On the other hand, Fleming

believes that hippomanes are nothing more than "inspissated parts of the allantoic fluid which were originally deposited on the membrane."

So much for those who cite the allantoic cavity as the home of the hippomane. W. Needham took an intermediate view, saying he found hippomanes in both the amniotic and allantoic cavities, but that in general they were larger in the latter.

Bernard and J. Needham are the two strongest advocates of the amniotic site of hippomanes. Bernard found them there in a series of studies on the placentas of ruminants, and because of their location called them amniotic plaques. He thought they originated from the wall of the amnion in a sort of metaplastic process. J. Needham cites no proof of his view, but insists upon recording hippomanes as amniotic in location.

In guinea pigs and rabbits, however, Bernard found the hippomanes in a new site, i.e., between the maternal and fetal portions of the placenta.

The syncytiotrophodermic origin and location of "placental balls" is held by Pinoy, Nattan-Larrier, and Letulle. In guinea-pigs and humans they found these "balls" originating from the syncytiotrophoderm, remaining attached there or dropping off and floating free in the maternal blood of the lacunae of the syncytiotrophoderm.

Composition and Function

In most instances the function attributed to a hippomane by an observer is dependent upon his conclusions as to the composition of the hippomane, so these two phases of the problem can best be considered together. One need be little surprised, in view of the limited knowledge upon other phases of this subject, to find that very little if anything, is known about the composition and function of hippomanes. In many instances there is direct contradiction between the reports of different writers, but this may merely be due to a difference in the stage of development of the bodies studied, for it is known that the composition changes as the gestation period advances.

Most writers do agree upon the basic organic nature of hippomanes. That is, no matter where located, it is believed that they arise from existing cellular tissue, and, therefore, are basically composed of degenerate cells without nuclei. Nattan-Larrier observed that in cases of diphtheria and typhoid there was a marked increase in "placental ball" formation. Pinoy noted a similar phenomenon in cantharides poisoning and attributed this to an increased destruction of syncytiotrophoderm cells. He reasoned that this definitely proved that physiological "placental balls" were detritus from physiologically killed syncytiotrophoderm. He considered the syncytiotrophoderm as "the equivalent of an epithelium at the level of which are made the nutritional changes between the mother and fetus: it works, it degenerates, and it regenerates." The "placental balls," then, were accumulations of these degenerated cells and they "are the equivalent of desquamated cells."

Bernard, though concurring upon the cellular composition of hippomanes, differed from Pinoy in that he believed them originally to be living, productive epithelial and glandular cells which manufactured glycogen. He found them microscopically to be cells containing nuclei, sometimes nucleoles and always granules which proved to be glycogen when subjected to the tincture of iodine test. From these observations Bernard advanced the theory that "amniotic plaques" are glycogenetic in function, and described them as "true placental hepatic organs" and "provisionary livers." He contended that they serve the fetus as organs of sugar metabolism until the liver develops sufficiently to assume its normal function (the third or fourth month), after which they degenerate, decrease in size, and often disappear entirely. When they are no longer needed one of two fates overtakes the amniotic plaques, according to Bernard: They may disintegrate, the glandular cells first losing their nuclei and glycogen and then becoming flattened, finally disappearing; or else fatty degeneration sets in and globules of fat and crystals of calcium oxalate infiltrate the "plaque."

It may have been hippomanes in this

latter stage of degeneration that Jenkinson had in mind when he described them as: "At first they are surrounded by a membrane—the remains of their covering of allantois and trophoblast—and are soft: they are composed of granular coagulable material, full of cell-detritus, degenerating nuclei, globules of fat and glycogen, and leucocytes. Later the membrane disappears, and the bodies become hard by being saturated with calcium oxalate in the form of 'envelope' crystals."

Letulle, however, found the syncytiotrophodermal "placental balls" to contain neither glycogen, fat nor mucin, but to consist of an "albuminoid material whose nature it is difficult to establish." Both he and Nattan-Larrier looked upon these bodies as a secretion of the placenta, attributing a secretory function to the placental epithelium.

From a purely chemical point of view Lassaigne[7] gives the composition of hippomanes as "little soluble albumin, much coagulated albumin, and 27% calcium oxalate."

Dastre also noted the high calcium content of hippomanes and thought he found a correlation between the greatest prevalence of the latter and the period of maximum intensity of ossification in the embryo and considered them associated in some way with the calcium metabolism of the embryo.

But after everything is considered, perhaps Beeman best expresses the present status of our knowledge upon this matter when he states, "their . . . use is unknown."

IIippomane in a Belgian Mare

Dec. 6, 1937, Dr. C. D. Ebertz was called out to the Kansas State College Animal Husbandry barns to remove a retained placenta from a 7-year-old, Belgian mare. Upon removing said placenta he encountered a large, greyish-tan body which he identified as a hippomane, this diagnosis being confirmed by Dr. E. J. Frick.

This hippomane measured 4x2¾ inches, being thin at its margin and rapidly thickening to a depth of 1½" at its center (see illustration). It had a total volume of ca. 140cc. The surface was roughened and it was tough and elastic in consistency. On cross-section it was found that the body was very definitely divided into a medulla and a cortex, the latter being ¼" thick.

Unfortunately the writer received the specimen after it had been in commercial formalin for one week so that chemical tests could not be made reliably. However, the hippomane was sectioned and examined microscopically.

The microscopic structure proved to be extremely interesting. The cortex was revealed as

View of Hippomane reported by the author.

a homogeneous, slightly acid-staining material which was vacuolated and granular and which contained scattered dead cells with acid-staining nuclei.

The medulla, on the other hand, was composed of decidedly living and apparently intensely active tissue. It contained an extensive fibrous connective tissue stroma with numerous mature fibroblasts. Throughout the stroma were scattered columns and islands of large, active, hyperchromatic, young epithelial cells with many mitotic figures evident, and an occasional tendency toward alveolar arrangement. The medulla was very vascular, being profusely supplied with congested arteries, veins and capillaries. There were several areas of degeneration and necrosis with invasion of leucocytic elements, especially polymorphs.

On the whole, this particular hippomane had very much the appearance of a large epithelial cell carcinoma.

Discussion

The single case described here is quite obviously atypical. Unlike other hippomanes that occur at term, it is neither small nor degenerate, but rather appears as a large, vascular, active structure, not unlike a rapidly growing carcinoma. The fact that it was not a carcinoma (carcinoma of the uterus; chorionepithelioma) was established by an absence of a tumor history in the mare, her good condition, and the hippomane's freedom from attachment to the uterus.

The conclusion reached was that it was a

hippomane that had failed to follow the normal course of degeneration in the later stages of pregnancy, but which had continued to proliferate in a hyperplastic process. Whether or not this had any relationship to the retention of the placenta is a matter of conjecture.

All in all, the hippomane under discussion seemed to present too extensive and active a structure to be functionless. What this function, if any, may be is unknown and provides a problem of definite interest, and perhaps importance, in the embryological picture. Work done to date upon this subject has been sporadic, contradictory, and inconclusive. A study of a large number of cases (perhaps best obtained from material in abbatoirs) from an embryological, structural, physiological and chemical viewpoint might bring to light some interesting and valuable information upon the nature and function of the hippomane.

Summary

1. A review of literature available upon the subject of hippomanes is presented, and the confused state of knowledge upon this subject is pointed out.

2. A hippomane found in the retained placenta of a mare is described macroscopically and microscopically.

The author wishes to acknowledge the assistance received from Dr. C. C. Morrill and Miss A. D. Kimball in the histological phase of this work.

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A Case of Tetrachlorethylene Poisoning in an English Setter

As a vermicide, tetrachlorethylene has become outstanding in veterinary practice. Hall and Shillinger[1] state that dogs have survived doses of 3, 5, 10 and 15cc per kilo, and that in cases in which contraindications are not present, dogs will tolerate at least 75 times the therapeutic dose.

In another article, Hall and Shillinger[2] again emphasize the fact that the general condition of the patient is of utmost importance in the administration of tetrachlorethylene. In this series of experiments death occurred in only three test animals, two following the administration of a therapeutic dose, the third following a dose only three times the indicated one. These facts when contrasted with the survival of dogs given much larger doses bear out the conclusion that death from these chlorine hydrocarbons follows from what may be termed individual susceptibility; this is usually due to the existence of lesions or depressed toxic conditions of the viscera or other organs most subject to injury by the drugs employed. In these and similar cases, Hall and Shillinger are inclined to think that death follows less from additional injury to the organs in question than from a toxic depressant action of the drug on the central nervous system, already seriously depressed by various metabolic disturbances.

The contraindications for tetrachlorethylene are probably identical with those for carbon tetrachloride and include: liver lesions (hepatitis, cirrhosis, degeneration or necrosis); toxic conditions from certain bacterial infections, or from such debilitating diseases as scabies or mange; extreme youth or old age; gastroenteritis (especially the hemorrhagic forms); con-

stipation; and the presence in the diet of alcohol, fats, oils, and other substances facilitating undue absorption of the drug.

Research has indicated that damage to the host following the use of the drug is definitely dependent upon its absorption from the intestinal tract.

November 23, 1937, a three-year-old English setter was presented to the veterinary clinic of the Kansas State College for examination. According to the owner, the patient had been in a general run-down condition for a period of three days. This was the first time that the dog had ever been sick. The owner had administered a two-ounce dose of castor oil. Noting no improvement after a few hours, he had removed the dog to a neighboring animal hospital, where it received a therapeutic dose of nema capsules, and was discharged after a short stay. Upon returning home with his setter, the owner noticed some peculiar symptoms which had not been evident previously, and it was these symptoms which caused him to bring the dog to the clinic.

The attitude of the dog was expressive of toxemia of the severest kind. It was comatose, giving no response to its environment. After much coaxing and prompting we were able to induce it to rise and move about a little. It was, however, evident that the dog had lost most of its powers of coördination. It would take a few uncoördinated steps, show a vertigo, and then collapse, returning to its original comatose state.

The temperature of the patient was 104° F., pulse 125, and respirations 25. The mucous membranes were almost normal, there being only a few petechial spots present. The dog was thin in flesh and markedly dehydrated. Its coat was coarse and the skin doughy on palpation. Examination of the nervous system showed it to be completely blind. Examination of the blood showed a calcium content of 6.98mg per 100cc of blood and a phosphorus content of 4.16mg per 100cc of blood, indicating a marked deficiency of calcium in the blood. A peculiar odor in the urine proved to be that of tetrachlorethylene.

A tentative diagnosis of tetrachlorethylene poisoning was made and treatment was instituted accordingly. The patient was given one intravenous injection of calcium gluconate and thereafter daily injections of glucose, together with symptomatic treatment and good care and nourishment; but it did not respond, and on the ninth day, the prognosis being hopeless, euthanasia was carried out.

A complete autopsy was performed which revealed the following: fatty degeneration of the liver giving the organ a mottled appearance; cloudy swelling and degeneration of the kidneys, the capsule stripping with a little difficulty; spleen normal; stomach mucosa hyperemic and hemorrhagic; intestines showed a catarrhal exudate and excessive amount of blood and bile; the blood vessels of the bladder and urethra were slightly injected and a mild cystitis was present. The remainder of the organs throughout the body appeared normal.

Microscopic sections of both the kidney and the liver were made. Examination of the liver tissue showed congestion, fatty degeneration, cloudy swelling and focal necrosis. The kidney showed marked degenerative changes such as: cloudy swelling, fatty degeneration and rupture of the tubules. Some areas of necrosis were present as evidenced by the pycnotic nuclei and caryolysis. The only pathological change present in the glomeruli was a slight congestion.

This case reënforces Hall and Shillinger's conclusion that the dosage of tetrachlorethylene is of secondary importance in producing a toxic effect, and that the presence of the drug's contraindications should be the prime consideration when its use is contemplated.

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A-Avitaminosis in Chicks

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The purpose in writing this report is to describe the antemortem and postmortem findings in chickens affected with A-avitaminosis and to make comparative notes with diseases that may be confused with it. Poultry diseases are not more difficult of diagnosis than diseases of other animals, yet many veterinarians neglect this important practice.

A-avitaminosis is not commonly met with in the average farm flock. In recent years, however, because of drouths, closer confinement, and use of commercial and substitute feeds it is becoming more evident. Deficiencies of this vitamin may be manifested in lowered resistance to disease and parasites, improper growth, low egg production, fewer chicks hatched, and higher mortality among those surviving.

In June and July, 1937, the author did the postmortem and bacteriological examination of a group of chicks that were on a vitamin A deficient ration.

The chicks used in this experiment were hatched from eggs laid by an experimental flock of single comb, white Leghorn pullets, which had been fed a ration of dehydrated alfalfa meal containing 5300 international units of vitamin A per 100 grams of feed. The chicks were wing banded and divided at random into groups of 24 each. They were brooded in battery brooders for four weeks and then transferred to heated pens in which sand was used as litter. Fresh water and mash feed were kept before them at all times, but no food containing vitamin A in appreciable quantities was given.

The first symptom to be noticed was leg weakness, closely followed by excessive lacrymal secretion, droopingness and ruffled feathers. Soon the chicks were resting on their hocks, and when forced to move did so with an unsteady gait. These symptoms were progressive until death. Daily weight records showed that just in advance of clinical symptoms a retardation of growth occurred. In but few cases were there any marked swellings about the head or excessive nasal secretions.

Macroscopic, post-mortem observations were made of all organs along with fecal examinations and routine cultures of the liver and bone marrow. Each chick was opened carefully and examination made of the skin, peritoneum, pleura, and pericardium. The entire alimentary tract was opened, as were the trachea, nasal cavity and the sinuses. Following this each of the remaining organs was studied.

Since no sections of the tissues were made the work of Wolbach and Howe[1] will be reviewed briefly to give a better understanding of the micropathology. The columnar epithelium becomes underlined with new stratified epithelium which completely separates it from the original mesenchymal support. Atrophy preceding keratinization is very slight if present at all and affects only the cytoplasm. The glandular epithelium is primarily involved and the keratinization of the duct precedes that of the acinus.

This abnormal epithelium is less resistant than normal epithelium to bacterial invasion, which accounts for the high occurrence of secondary infection described by some workers. Various workers report the finding of a large number of bacteria in the upper respiratory tract and conjunctivæ but usually are unable to find specific organism responsible for the purulent condition that exists. The virulence of the invading organism will, to a large extent, determine the lesions of the conjunctivæ, nares and sinuses. In routine culturing of the liver and bone marrow only three chicks were found infected with secondary organisms and in each case a different organism was found; *S. pullorum, E. coli* and *Proteus sp.*

On both antemortem and post mortem examination conjunctivitis was found in all cases, the lesions varying from slight hyperemia and lacrymation to considerable swelling and a purulent mass in the conjunctival sac.

The epithelium of the kidneys and ure-

ters undergo keratinization early in the disease and through interference with normal secretions deposits of urates are seen in these and other parts of the body. The deposition of urates in the kidneys and ureters varied greatly in amount but was seen in all cases. Elvenjem and Neu[2] found that the uric acid in the whole blood is increased from a normal of 5mg. per 100cc to an average of 44mg. per 100cc. Deposits of urates were found in other areas, in the order named: pericardium, pleura, peritoneum, bursa of Fabricius and spleen. Urates beneath the liver capsule were not seen in any of the chicks.

Keratinization of the epithelium caused varying sized nodules quite consistently on the mucous membrane of the mouth, esophagus, proventriculus and, to a lesser extent, on the crop and trachea. The nasal passages and sinuses showed no visible lesions at first but later showed congestion followed by a purulent exudate that in some cases caused swelling about the head. Further along the alimentary tract, lesions quite diagnostic of the disease were found. The proventriculus was enlarged in 65% of the cases and showed marked atrophy of the muscular walls in 11%. The mucosa appeared watery and swollen at first, and this condition gave way to keratinization and ulceration in the cases of longer standing. Lack of gizzard factor was noted in 42% of the chicks. The intestines showed progressive degeneration of the epithelium until they were thin and void of tone. The changes in the ceca closely resembled those observed in the intestines. The involvement of the bursa of Fabricius is one of the most characteristic lesions seen in this disease. The first six chicks necropsied showed no macroscopic involvement, but those following showed lesions ranging from a swollen mucosa with collected mucous exudate to a purulent mass, that in some cases contained urates.

The lungs, liver, spleen and heart muscles showed no consistent lesions.

Summarizing the pathology, conjunctivitis and deposition of urates in the kidneys and ureters were found in all cases studied. Following this the most consistent gross lesions were the enlargement of the proventriculus, caseous exudate of the bursa, and the keratinization of the epithelium of the mouth and esophagus. These lesions vary a little from those described by Beach[3] but in this experiment the chicks were somewhat younger than those he studied. In general it may be said that the same lesions will be found in mature birds except for the bursa lesions, which will not be present because of the atrophy of that organ in the adult.

Three conditions are common in chickens that may be confused with A-avitaminosis. These are coryza (infectious roup), fowl diphtheria (pox) and laryngotracheitis. It must be remembered that any of these conditions may be found in combination with any other.

In coryza the onset is usually rapid and the birds are noticed to have a "head cold". The nares, sinuses and conjunctival sac are soon filled with a purulent exudate that usually causes a marked swelling of the head. There is usually seen an edema of the eye lids that is not common in A-avitaminosis. A check of the feed, housing and weather conditions may be an aid in differentiating infectious from nutritional roup.

Fowl diphtheria is an atypical form of fowl pox which forms diphtheritic membranes in the mouth, larynx and nasal cleft. Usually an examination of some of the other birds of the flock will show typical pox lesions. The diphtheritic membrane is removed with difficulty and leaves a denuded area that will usually bleed. This is different from the purulent exudate in either of the roups, which is easily removed and leaves no denuded area.

In laryngotracheitis the primary organs involved are the larynx and trachea. The common lesion in this disease is petechial hemorrhage and a mucoid degeneration of the epithelium of the larynx and trachea. In this disease the onset is usually sudden, with the birds coughing and gasping for breath. The entire flock often will be affected at the same time, and unless secondary conditions arise there will be no lesions other than those described.

If A-avitaminosis is recognized before

the birds have reached a condition in which they are unable to eat, recovery may be expected if the diet is supplemented with feeds high in Vitamin A. The best sources of this vitamin are fish oils, green feeds, dehydrated alfalfa and yellow corn.

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Acknowledgment is also made to Doctors Bushnell and Twiehaus, Bacteriology Dept. K. S. C., for assistance and guidance.

Sinusitis in a Cat

On January 21, 1938, a seven-year-old female white Persian cat was presented to the veterinary clinic of the Kansas State College for diagnosis and treatment.

A circumscribed swelling was apparent just lateral to the right eye, as shown in the accompanying illustration. This type of swelling had intermittently appeared and ruptured above, below and lateral to the right eye at various times for the past seven months, discharging a viscid mucus tinged with blood. The resulting fistula healed after two to three weeks. The cat would become depressed and refuse her feed about four days before a swelling ruptured; becoming brighter after the rupture occurred. An area about the size of a large pea just above the right eye, the seat of a previous fistula, showed a new growth of hair. Keratitis of the affected eye extended from the medial canthus to the middle of the cornea. An excessive, clear, lacrymal secretion was also evident. The right, third premolar was suspected of being the cause of the swelling. Upon close examination a small area of the gingiva on the medial surface of the tooth was found to be necrotic.

The following treatment was carried out. The cat was confined on the operating table and ether was administered in relays so as to permit complete anesthesia throughout the operation. The gingiva was separated from the third premolar tooth and a pair of small dental forceps was used to accomplish an extraction. When the tooth was removed a thick mucus escaped from the alveolus and the swelling immediately receded. With the use of a probe, a fistula was located between the alveolus and maxillary sinus and was enlarged to aid drainage. The alveolus was then swabbed with tincture of iodine. Examination after the tooth was extracted revealed that the necrotic area observed on the gingiva communicated with the root of the tooth which was abscessed.

The following description of the third premolar of the cat is offered. The adult cat has the dental formula of 2 (I 3/3 C 1/1 PM 3/2 M 1/1) = 30. Of the three premolars the third is the largest. This tooth has three roots; anterior, posterior, and medial. The anterior and medial roots almost puncture the floor of the maxillary sinus. The three roots are vertical to the crown and this makes splitting of the tooth unnecessary for its extraction.

The writer observed the cat three weeks later. At that time the condition was corrected, except for the keratitis which was gradually clearing up. The owner reported that there had been no evidence of a swelling since treatment and the cat was feeling much better than she had since the condition had first begun.

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"Swamp Fever" in the Southeast*

By W. B. HIRLEMAN,
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MY practice is in the largest cotton producing county (Burke) in Georgia. Large plantations are the rule and mules are the motive power. Last year this county imported 1300 mules. Tractors depreciate in value two-thirds in a year under the conditions obtaining on our plantations, but mules depreciate very little.

When I came to Burke County 17 years ago, I found the laity were familiar with a condition in mules and horses, strikingly similar in history, symptoms and termination to infectious equine anemia, which we are told is a virus disease characterized by certain well-known symptoms and running a definite course. Strangely enough this disease has long been called "swamp fever" in these parts.

The affected animals are found in all degrees of flesh from fairly fat young mules on large plantations, to the old, poor, starved animal of the one-mule, colored renter. Between March 1st and the middle of August, seems to be the most favorable time for this condition to appear, but sporadic cases occur throughout the year.

The history of these cases is that the animals had not been sick, were eating well and working as usual. Then, as the owners would say, "they began to slow up" and seemed to be "weak in the loins." They might be rested up for a few days, during which they would be given special feed and care, and soon appear to be strong and well, but when returned to work would again weaken as before. Many were reported to have depraved appetites and after eating a full portion of grain and roughage, would eat sand and soiled litter from the stables and lot. Attacks of indigestion were common also.

UPON examination the following symptoms would be found: Coat dead and staring; old hair remaining long after shedding period; eyes listless; hemorrhagic splotches on conjunctivae; occasionally edematous swellings on breast, belly, sheath or flanks; all mucous membranes pale or dirty yellow; foul, insipid odor from mouth; tail limp and floppy; urine yellow, thick and muddy; bowels soft, but not loose. If there were any cutaneous wounds from harness or scratches from any cause, difficulty was experienced in getting them healed.

These animals tire easily and if worked continue to get weaker until difficulty is experienced in getting them up after they have lain down. If an animal unable to rise be propped up on the sternum, it eats ravenously, or if assisted to its feet, it can go very well and even do work. One mule is recalled that worked all summer, although it had to be helped to its feet every morning. Fecal specimens always reveal many strongyle ova. The strongyle are blood suckers and no doubt also eliminate poisonous products in their process of growth.

FOR several years, we tried various worm capsules and mixtures in the treatment of these cases, with varying success. Two years ago, we adopted the following routine treatment, which has proved highly satisfactory:

Fast for 36 hours, then with the stomach tube and funnel attached, give six to ten drams carbon tetrachloride, followed immediately by one pound of sodium sulphate dissolved in one gallon of warm water. Feed lightly after four hours. For the next 20 days, give in the feed morning and night, one tablespoonful of a worm powder composed of:

Copper sulphate	10
Iron sulphate	20
Pd. areca nut	47½
European worm seed	20
Arsenic	2½

Animals treated in this way make a really remarkable recovery. There is no permanent benefit in treating one animal in a lot or in treating all animals in the lot and not following up by removing all litter from the lot and stables, plowing the lot if possible

*Presented at the annual meeting of The Southern States Veterinary Medical Association, Atlanta, Georgia, October 14-16, 1937.

and changing pasture. Fecal examinations should be made every three months. In fact, the McLean County system of swine sanitation should be applied to mules and horses. It is practical, it is efficient and in the end, it pays dividends. Uncontrolled, this condition is serious. I have seen as many as eight mules down on a plantation, at one time, and have known the loss to run as high as 23 mules on a single plantation in a year. About 200 cases occur in my practice yearly.

NINETY percent of all equidae coming into my hospital show worm ova in some degree. Fecal examination is routine. Every dirt-eating mule and every case of sand colic I have seen in my practice in the last few years have been heavily infested with strongyle, which, by depleting the system, create an appetite for earthy material. Then too embolic colic must be charged up to the same cause.

The syndrome is so similar to infectious anemia and the term strongylosis is so difficult for the layman to understand, that in Burke County, we continue to call it "swamp fever."

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Needed Meat Inspection

Approximately one-third of our meat supply has inadequate or no meat inspection. This lack of protection constitutes a liability to public health and is a menace to the other two-thirds of the meat supply that has adequate inspection. It is also a liability to the live stock industry in that needed information concerning the location of animal diseases is withheld from live stock owners. It is also a serious handicap to animal disease control work. More than 36 million uninspected carcasses were sold in 1935. On the basis of condemnations in inspected plants from 150,000 to 200,000 of these carcasses should have been condemned as unfit for food. No available records indicate such condemnations, and it is assumed that most of these unfit carcasses were consumed by an unsuspecting and unprotected public.

Streptococcic Mastitis

Diernhofer[1] examined 1,117 cows for mastitis and found 518 or nearly 50% of them affected. This high percentage does not, however, correspond with the practical reality. Evidently it is too high. The loss in milk yield was studied. Affected quarters were found to yield 30% less milk than sound quarters. Computed on the basis of 1,200,000 cows in Austria, the decrease on account of mastitis is 36,000,000 liters annually.

The most promising treatment for latent mastitis is infusion of the mammary gland with dyes of high antiseptic value. Trypaflavine was found to be superior to the acridine derivatives. In fact, its action was found to be 30 times greater than the acridine dyes tested. It has active antiseptic properties in dilutions as high as 1:12,500.

In attempts to eradicate mastitis from dairy herds, it is important to treat all cases, not only the more pronounced ones. Detecting all the affected cows, isolation and elimination must be carried out to develop a mastitis-free herd. Much, therefore, depends upon precise and rapid diagnosis, and maintaining control measures for a long while.

The best time to treat mastitis in cows is between lactation periods. The infusion treatment should begin eight days after drying up. A solution of 100cc of trypaflavine diluted 1:12,500 is injected into the milk cistern and milked out, whereupon 800 to 1000cc of the same solution is infused into the cistern and gland and left there 48 hours before milking it out. The treatment is repeated every eight days.

To dry up an incurable quarter, infuse the gland with 800 to 1200cc of 0.03% of trypaflavine and do not milk it out.

Police measures should include prohibition of the sale, as milkers, of affected cows, controlling the sale of their milk, and aiding dairymen in bearing the expense entailed by the effort.

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[1] Diernhofer, K. Abs. *Annales de Médicine Vétérinaire* 82:4, November, 1937.

The Ultra-Viruses*

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The study of ultra-viruses, also named filterable viruses, filtering viruses, invisible viruses, ultra-microscopic viruses, is one of the most important and impressive questions of bacteriology at this moment. It interests the veterinarian as well as the biologist; it comprises a domain of surprising diversity because it implicates medicine and biology up to the highest conception of philosophy and metaphysics—in effect, the existence of ultra-viruses presents problems which touch the very origin of life.

Definition.—The ultra-viruses are viruses having dimensions inferior to those of the smallest known microbes capable of provoking more or less grave diseases in the different living beings.

They are characterized by their exclusive affinity for protoplasm of living matter and by their property of passing through filters which retain ordinary figured elements. Moreover, they are, in the main, invisible and incapable of cultivation on the ordinary media of the laboratory.

History.—The first idea of invisible viruses dates back to the memorable work of Pasteur on rabies. This famous scientist who, in 1880-1881, had tried in vain to put in evidence the "microbe of rabies", coined the hypothesis that the discrete rabies virus is too small to be seen with the aid of the microscope.

As Roux expressed it so well, in 1898, the invisible germs are but "beings of the mind." They became realities at that time when, one after another, four diseases were attributed to viruses of this nature, namely: foot-and-mouth disease (Loffler and Frosch); contagious pleuropneumonia of Bovidae (Nocard, Roux, Salimbeni); myxoma of the rabbit (Sanarelli); and mosaic disease of tobacco (Beijerinck, cited by Philibert).

The start was thus made! Investigations and researches were launched in every country of the world on old and new diseases the pathogenic agents of which remained among the unknowns. Each year various ultra-viruses were discovered until, at the present hour, the list exceeds one hundred.

Confounded at first with soluble ferments, enzymes or toxins, it was soon found, contrary to the diastases, that the potential of the ultra-viruses is not in their action; that they grow and multiply; that they seem like living beings in the biological sense. On the other hand, their mode of assimilating, developing, adapting and reproducing, their resistance or sensitivity to physical and chemical agents, strikingly differentiated them from ordinary microbes.

The ultra-viruses, therefore, constitute a special class among the pathogenic agents of man and animals, especially since their nature — living or non-living — has been questioned through the work of Stanley and Wyckoff.

Nomenclature and Species Affected.—Ultra-virus infections are encountered in all living beings. Was it not d'Herelle who, in 1916, discovered the strange properties of bacteriophage, an ultra-virus of considerable pathogenic power in regard to certain microbian species which possesses the faculty to lyze young and living germs within their cultural substratum? The discovery of d'Herelle was fruitful from the beginning because it was capable of clarifying mysterious properties of ultra-viruses and, in addition, of being used therapeutically.

Numerous diseases of plants are provoked by ultra-viruses: mosaic disease of tobacco, of potatoes, of cucumbers, of lettuce, of cabbage, of roses, of spinach, of maize, of sugar cane, of beans, of bananas, of broom rape, etc.; the disease that wilts the leaves of the potato plant, etc.

The type of these maladies is mosaic

* Translated from *Recueil de Médecine Vétérinaire*, 1937. 113:651-679, by L. A. Merillat, Director of Publications, Haver-Glover Laboratories.

disease of tobacco, characterized by the appearance of white spots, then brown, on the leaves of the young plants. The leaves become marbled owing to the juxtaposition of the clear green spots and the deep green blemish which, by grouping, form a veritable mosaic. The disease is highly contagious through the dust of the dry leaves, the prick of insects, the tools of the gardener, the fleas, all of which are apt to transmit the virus. The ultra-virus of mosaic disease of tobacco is extremely resistant, and as shown by Oltsky and Northrup recently, it is identical with that of tomato and potato.

Insects and fish also pay a not negligible tribute to the processes unlatched by ultra-viruses: on the one hand, disease of the larvae of bees, *maladie du couvain*, polyhedric disease of Paillot such as the fat of the silkworm, infection of the caterpillars of Pieride of the cabbage; and on the other, variola of the carp, epithelioma of the barbel, fish disease of Brazil.

Ultra-viruses cause many diseases of fowl. Among them are fowl pest, diphthero-variola (avian diphtheria and contagious epithelioma), psittacosis, laryngotracheitis, epidemic encephalitis of chicks, etc.

In mammifers, filterable virus diseases appear to be the most redoubtable. In the horse, there is rabies, the different forms of encephalitis (Borna disease, American encephalomyelitis), typhoid fever (influenza), infectious anemia, horse pest, contagious pustular stomatitis, horse-pox, periodic ophthalmia, cough of Hoppegarten; in the ox, rabies, variola, foot-and-mouth disease, pustular stomatitis, rinderpest, infectious bronchitis, infectious bulbar paralysis, the contagious encephalites, gangrenous coryza, contagious pleuropneumonia; in sheep, rabies, sheep-pox, agalactia, louping ill, fever of the Valley of Rift, contagious pustular stomatitis, pernicious anemia, infectious laryngotracheitis; in the goat, pleuropneumonia; in the dog, rabies, distemper, infectious bulbar paralysis (Aujeszky's disease), infectious anemia; in swine, rabies, foot-and-mouth disease, enzoötic encephalitis, cholera, influenza, infectious bulbar paralysis, exfoliating exanthema; in the cat, cat distemper, infectious gastroenteritis, infectious laryngotracheitis; in wild carnivora, managerie typhus (Urbain), encephalitis of the silver fox. In 1935, Mlle. Cordier and Ménager inquired whether osteoporosis of swine in Tunis is not provoked by an ultra-virus because injections of filtered blood or of spleen reproduced the morbid process.

The small laboratory species are likewise susceptible to the pathogenic action of ultra-viruses. *La peste* and poliomyelitis of the guinea pig, myxoma of the rabbit, infectious ectromelia and lymphocytic choriomeningitis of mice, are all of this origin.

The human being does not escape; variola, alastrim, foot-and-mouth disease, herpes, encephalites, poliomyelitis, dengue, yellow fever, grippe, coryza, mumps, roseola, and Nicolas-Favre disease, all attest to the exquisite sensitivity of man to ultra-viruses.

Thus, in all domains of life, the infections fulminated by ultra-viruses are numerous. The list enlarges daily; each day, however, it may be reduced through a more precise understanding of the properties of these pathogenic agents or by the discovery of their visible form. At the present moment, work is being done toward dissociating the agents of pleuropneumonia, agalactia and psittacosis from the cadre of ultra-viruses.

The study of cancer has also profited by the discovery of ultra-viruses and the problem of infectious origin of certain tumors, spontaneous in man and animals, is now presented with impressive interest. Already in 1909, Peyton-Rous described a tumor developed in the pectoral musculature of a plymouth rock. This discovery, which was a profound sensation, has since raised lively discussions yet to be weighed. In effect, the tumor was a fuso-cellular sarcoma transmissible to chickens in series, not only by grafting but also by inoculation of the filtrate of the tumor.

In 1908, Ellerman and Bang isolated the virus of leucemia of fowl, an entity now named avian leucosis. These leucoses can be divided into three groups according to the signs by which the process manifests

itself; lymphoid leucosis, myeloid leucosis, and erythro-leucosis. If the lymphoid, the most frequent type, does not seem to be transmissible by the inoculation of filtrate deprived of neoplastic cells, the other forms of the malady can be reproduced by injections of a filtrate containing no cellular elements.

The papillomatoses, cutaneous, benign tumors encountered in man and certain species of animals, also bring forth the cytocinetic action of ultra-viruses. Shope has studied this point particularly well since 1923 in vivary rabbits and transmitted papillamatoses in series from domestic to wild rabbits. The virulent element passes regularly through the Berkefeld filter but irregularly through the discs of Seitz. It is destroyed by heat at 70°, conserves well in glycerin, and shows a manifest preference for the dermis, which accounts for the cutaneous localization of the neoplasm.

Physical Properties.—Filtration — filterability is incontestably a quality common to all ultra-viruses and this explains the appellations "filtering virus" or "filterable virus" so frequently mentioned. The expression is improper as it is known today that besides the so-called filterable viruses there exists a class of elements possessing the same property in the course of their evolutionary cycle: filtering forms of spirochetes, protozoa, and bacteria (bacillus of Koch, typhoid bacillus).

Filtration is always a difficult operation, always delicate and often uncertain; its rules are still badly understood and inexact, with the result that the bacteriologist risks the making of a double error: pronouncing a visible germ an ultra-virus that was retained by the filtering substance, or eliminating from the cadre of ultra-virus a virus arrested on the surface of the filter because of bad conditions of the filtration.

Filtration is carried out by the employ of mineral or sometimes organic substances. Among the first substances used are: plaster (first filter of Pasteur); kaolin, diatomaceous earth (Berkefeld filter); the porcelain of Pukall and Chamberlain. The Chamberlain filter, well known in France, has different forms, dimensions and porosity according to its usage. Certain Chamberlain bougies allow very fine microbes (type L) to pass; others retain ultra-viruses of large dimensions (type L9, type L11); and thus through the whole gamut of porosity capable of satisfying every need and desire.

Filtration can also be accomplished through mineral masses, especially soft; amianthus (disc of Seitz); sand, charcoal, or such organic substances as gelatin, gelose, collodion.

Whatever filter is used, filtration is not a simple physical operation. The filtering membrane does not represent a sieve with holes of a diameter inferior to the dimensions of the microbe; on the contrary, the pores of filters are generally much larger than the germs, which would be capable of passing through them as "a train runs through a tunnel" if the adsorption power did not fix them to the wall of the filter when they arrive in the pores of the bougie.

The laws that rule these phenomena of adhesion and adsorption are not understood at the present time. We know, however, that a good filtration depends upon numerous conditions:

(a) Intrinsic conditions.—These apply to the electric charge of the liquid to be filtered, its pH, its temperature, its content of albumen, its viscosity, the nature of the excipient (distilled water, physiological salt solution, bouillon, serum, etc.). The pH has a manifest although sometimes unsuspected influence. Botulinus toxin filters well while its pH varies from 5.5 to 7, but is retained when the pH goes to 4. The same phenomena obtain in the virus of foot-and-mouth disease, which in a neutral solution of 7.5 passes readily through a Chamberlain L5, much less through L9, and is totally arrested by L11. By contrast, suspended in a strong alkaline solution of pH 9.5 it passes regularly through L11.

(b) Extrinsic conditions.—These concern the electric charge of the membrane or of the filtering substance, its porosity, its possible *colmatage,* and the manner in which the sterilization was done. They are subject also to three variables of capital

importance; the duration of the filtration, the pressure used, and the temperature.

The technique of the filtration and the search for the virus in the filtered liquid are infinitely delicate operations of bacteriology. Of importance are: clarification of the liquid to be filtered, mounting the filter, speed of filtration, control of sterility, choice of the species of animal destined to receive the injection, dose to inject, point of inoculation, etc.

The interpretation of the results are not easy; the practitioner always knows that the filtration deprives the liquid of a part, more or less, of the virulent elements, and that from the time an inoculation is made in a susceptible species, the period of incubation is long, the symptoms weak and effaced. The observation of the subject inoculated should, therefore, extend over several weeks, or perhaps months; and inapparent infections and secondary organisms should be guarded against. It is always indicated to effect passage in series.

Ultra-Filtration. — Hauduroy defines ultra-filtration as that effected through membranes constituted of colloidal material, membranes finer and tighter than those of ordinary filters. The type is collodion.

Numerous substances have been preconised for this purpose, namely: goldleaf, parchment paper, gelatin, gelose, rubber, collodion. The latter is the only one now used. The ultra-filters are not exempt from the faults of ordinary filters, but possess them in lesser degree. Always the rôle of alkalinity and acidity of the media, the presence of electrolytes, the pressure, the duration, the temperature, and the viscosity of the solution, of the collodion used, etc., must be weighed.

The study of ultra-filtration enables one to measure the dimensions of the ultra-viruses. In effect, the passage of a colloidal solution the particles of which have known dimensions (ovalbumin, hemoglobin) through an ultra-filter having pores of certain dimensions enables one to titer the filter and thus measure the microbic elements. The unit of measurement of such material is not the micron, that is to say, the millionth of a meter, but the millimicron or the millionth of a millimeter. As will be seen below, the dimensions of ten or more ultra-viruses have been determined.

Adsorption.—Carré and Vallée were the first to show (in foot-and-mouth disease virus) the faculty of adsorption of a virus by other cellular elements. Red blood cells in contact with foot-and-mouth disease virus, washed several times after the mixture has been centrifugalized, are still capable of reproducing the disease in susceptible animals. The same process of adsorption can be realized by substituting staphylococci for red blood cells. After centrifugalization and multiple washings, the inoculation of cows with these staphylococci transmits foot-and-mouth disease absolutely identical to that of a natural infection.

This fundamental experiment, writes Philibert, clarifies at once the pathogenesis of infectious diseases. It explains clearly the errors of the past in attributing to visible germs pathogenic properties they do not possess. It should put one on guard in the future against accepting too readily a visible pathogenic agent in a disease the anatomo-clinical character of which seems to point to another origin.

The adsorption of ultra-viruses by means of non-living particles (kaolin, hydate of alum) permits the purification of some of them. The method has been applied in recent years to bacteriophage and to the preparation of foot-and-mouth disease vaccine.

Invisibility.—The ultra-viruses are ordinarily invisible, notwithstanding our optical methods of investigation. However, two techniques, based on two different principles, may be employed to put them in evidence:

(a) Illuminating the microscope with very short waves.—The source of light is represented by ultraviolet irradiations which, unfortunately, are imperceptible to our eyes and unable to pass through the glass of the optic system of the usual microscope.

The difficulty has been overcome by the

construction of special microscopes and by substituting for the unaided eye photographic plates sensitive to ultraviolet rays. Up to the present time, however, the results obtained do not correspond to our hopes and if some have pretended to have seen the virus of foot-and-mouth disease, for example, the discovery has not been confirmed.

(b) Surcoloration.—Refers to the technique of Borrel which by its simplicity, ease of execution and elegance, has given encouraging results. It consists of surrounding the virulent elements of a specimen with a kind of stain that augments the dimensions of the ultra-virus and exposes it to microscopic examination.

Borrel in this manner has rendered visible the virus of molluscum contagiosum of man, of vaccine, and bacteriophage. But the surcolored granulations appear identical for all of these viruses, and it seems that the examination of the virulent particles can in no case aid in identifying the morbid process or the virus in question, nor aid in the specific diagnosis.

Dimensions.—The method of ultra-filtration permits one to determine the dimensions of the ultra-viruses. The following table expresses in millionth millimeters, the dimensions of the principal elements:

Materials	*In μ μ*
Staphylococcus (taken as a term for comparison)	1,000
Ricksettsia	300
Virus of psittacosis	250-300
Virus of molluscum contagiosum	250
Virus of vaccina Virus of variola	150-175
Virus of herpes	150-175
Virus of ectromelia	120
Virus of rabies	100-150
Virus of Borna disease	100-125
Virus of pseudo rabies	100-150
Virus of Influenza	80-120
Virus of the fibroma of Shope	100
Virus of vesicular stomatitis Virus of fowl pest Virus of the sarcoma of Rous	75-100
Virus of fever of the Valley of Rift Virus of louping ill Virus of poliomyelitis	25
Virus of foot and mouth disease	10
Ovalbumin molecule	4

The Action of Physical Agents.—(a) Heat.—The resistance of ultra-viruses to heat is extremely variable. Most of them, however, are destroyed by heating several minutes at 55° to 60°, although the virus of mosaic disease resists 80° to 90°. Some viruses resist long exposures at 37°, while others rapidly lose their virulent properties under the same conditions.

Heat is, in reality, the best means of destroying filterable viruses and it merits a prominent place in the methods of sanitary prophylaxis.

(b) Ultra-viruses are particularly resistant to the action of cold. The temperature of liquid air (—180°) leaves most of them indifferent. This resistance has an interesting practical sanction in the conservation of their pathogenic properties.

(c) Dessication.—Dessication varies in its effects according to its rapidity. A rapid dessication is less destructive than a slow one.

(d) Pressure.—High pressure can modify or destroy ultra-viruses. While they resist a pressure of one to two thousand atmospheres, they become inactive under higher pressure, becoming inferior generally at 5,000 atmospheres. The viruses of foot-and-mouth disease and of rabies attenuate at 3,000 and 4,000 atmospheres, respectively, and lose their virulence entirely at 4,000 and 5,000.

Chemical Properties.—Action of Antiseptics.—The antiseptics have a characteristic destructive power on ultra-viruses. By contrast, glycerin at 50%, under certain conditions, does not alter the vitality nor the virulence of most of them; rabies, poliomyelitis, herpes, encephalitis, variola of fowl, etc.

Photo-dynamic substances such as methylene blue in high dilutions, toluidine blue, *gonacrine,* or crystal violet, have the property of inactivating certain viruses: rabies, herpes, human encephalitis, hog cholera, Carré's disease (canine distemper), fowl pest, etc. The virus of rabies and that of hog cholera, however, retain their vaccinating properties after being thus attenuated. They are capable of conferring immunity to inoculations of fixed

rabies virus in rabbits and to hog-cholera virus in susceptible swine, respectively.

Biological Properties.—Morphology and Cellular Inclusions.—The methods of surcoloration have not yet disclosed the form and texture of ultra-viruses. But in several affections provoked by these agents, one encounters in the protoplasm or in the nucleus of certain cells some entirely independent formations foreign to the normal constituents of the cells, of which Negri bodies, found in the nerve cells of the horn of Ammon and the hippocampus of rabid animals, are the prototype. These special formations, which have incited many polemics not yet appraised, constitute the "cellular inclusions" which, as in the case of Negri bodies in rabies, play a considerable rôle in the histological diagnosis of the process.

Typical cellular inclusions have been disclosed: in contagious epithelioma of fowl (Borrel, 1904), rabies (Negri and Mme. Negri, 1904), smallpox (Paschen, 1906), canine distemper (Sinigaglia), molluscum contagiosum of man (Goodpasture and Woodruff, 1931), psittacosis (Lewinthal, Coles and Lillie, 1930), ectromelia of mice (Barnard and Elford, 1931), epithelioma of canaries (Burnet, 1933), infectious myxomatosis of rabbits (Van Rooyen, 1937), etc. The virus diseases of plants and insects (polyhedric disease of Paillot) cause the formation of "inclusions" in the parasitized cells.

In certain infections (Borna disease, herpes of man, silkworm disease, etc.) the inclusions are localized in the nucleus of the cell.

The nature of the phenomena has been variously interpreted. Some have considered these bodies to be the virus itself or at least its chosen location—the Negri bodies of rabies, for example, which are capable of disintegrating into elementary corpuscles much smaller than the limit of visibility and of passing through certain filters—and have held that it is these particles, named the initial corpuscles or corpuscles of Volpino, which constitute the active pathogen. It was to these corpuscles that Von Prowazeck gave the name of "chlamydozoa", which is to say, protozoa surrounding the nucleus of the parasitized cell like a shirt.

Other authors—and these are the more numerous—refuse to recognize the cellular inclusion as the parasite, believing that it is simply due to the reaction of the infected cell to the pathogenic element.

Unity and Plurality.—Bacteriology has disclosed the existence of varieties or types of some microbic agents: Pneumococcus, I, II, and III; *Clostridium botulinum*, A, B, C, D, etc. The same fact applies to the ultra-viruses.

The unity of certain of these viruses has been recognized by various experimenters. Remlinger and Bailly have remarkably clarified the absence of plurality of rabies virus, contrary to the previous affirmations of Puntoni. Rabies virus is the same in all countries, always identical. One need not mention here the virulent types; the differences observed between street viruses relate merely to pathogenic power. It is thus that the virus of Sassano and of Koritzschoner appear singularly virulent for experimental animals.

The plurality of other ultra-viruses is manifest and everywhere accepted today. Vallée and Carré, and Waldmann and his co-workers have been able to identify by their experimental cross immunity three types of foot-and-mouth disease virus, designated respectively O, A, and C. These varieties are stable, and it does not seem, despite the opinion of Manninger, that they are reversible or that they can be transformed one to the other. Although they fulminate an identical malady in its morbid manifestations, one cannot be vaccinated against the other; this is a matter of capital importance in interpreting outbreaks of the disease, in the preparation of vaccines, in utilization of the different methods of immunization (vaccination and preventive serotherapy), and in therapeutics (antigentotherapy and curative serotherapy). It is necessary that serums and vaccines possess a polyvalence comprising the three types to be used with any degree of success in combating the disease.

This disparity of ultra-viruses is found

also in other infections of men and animals: encephalitis and poliomyelitis of man, equine encephalomyelitis with its two American viruses, fowl pest, vesicular stomatitis with its two virulent types, Newcastle disease, Egyptian, Corean, and Indian pests. . . .

Variability.—Attention has been drawn to the relations that exist between certain virus diseases, one being considered as caused by a highly virulent form, and others by less virulent forms of the same virus. Smallpox and alastrim, exanthematous typhus and Brill's disease, encephalitis and herpes of man, may be cited as examples. In animals, certain authors have considered foot-and-mouth disease and vesicular stomatitis from that point of view—the one attenuated is but the other (K. Wagner). To Nikolic, the virus of infectious bulbar paralysis is but a non-transmissible (for man), asthenic rabies virus. The varicellae are but two different clinical expressions of the same pathogenic agent (Netter and Urbain).

Physiological Properties.—According to the imaginary expressions of Hauduroy, the ultra-viruses are biotrophic; that is to say, they cannot live, proliferate, and develop except in the presence of living matter.

(a) Culture *in vitro.*—The cultivation of ultra-viruses is not possible under the usual technique of bacteriology, which employs dead organic material in the preparation of media. The most recent experiments of Eagles and MacClean demonstrated that the multiplication of the different viruses in substrata not containing living cells is not obtainable. The condition indispensable to success in culturing viruses *in vitro* is the use of living material (Waldmann).

One must use an artifice: the culture of tissue after the method of Harrison, Burrows and Carrel, which permits at this hour in the most elegant fashion the development of ultra-virus outside the living body. This technique, but faintly exploited, permits one to hope that in the future it will bring progress that will clear up the experimental studies of ultra-viruses as well as the methods of medical prophylaxis and specific treatment.

It was Parker and Nye who, in 1924 and 1925, were the first to cultivate the virus of smallpox outside the animal body. We now possess cultures two to three years old, in which we still find specific figured elements (corpuscles of Paschen and Guarnieri) which are as virulent as the original material.

The accompanying table, borrowed from a magistral report of Waldmann at the last meeting of the *Office International des Epizootics,* clarifies the various species of viruses which have, up to the present time, been cultivated.

[The author presents four pages of tables containing a list of 28 virus diseases in three classes (dermatrophic, neurotrophic, and miscellaneous), the specific virus of which has been cultivated in vitro. The tables include the names of the authors and year, the number of cultures made successfully, and the tissular media employed for each culture.—Ed.]

The technique of culturing viruses *in vitro* has undergone numerous changes. At first, the method of cultivating by drops was used. Since then culturing *en masse* in flasks has been employed; the flasks of Carrel, of Froenkel, of Waldmann, etc. . . .

The indispensible media is essentially composed of a solution of minerals, more or less complex (solution of Tyrode, e.g.), of a fibrinous coagulum of blood plasma, embryo juice, and a tissue chosen for the particular virus to be cultivated.

The third technique, handier and more elegant, is due to Goodpasture, Woodruff and Buddingh, who have shown that various ultra-viruses can be cultivated on the chorio-allantoid membrane of the hen's egg when cultivated at 39° for twelve days. In an egg, nature furnishes the prepared media and at the same time the necessary vehicle, but it is regrettable that all of the species of viruses, especially that of foot and mouth disease, cannot be cultivated by this simple procedure.

In this fashion, it has been possible to cultivate the virus of variola and its varieties, the virus of herpes, of roseola, of vesicular stomatitis, of equine encephalitis, of fowl pest, of infectious laryngotracheitis, of human influenza, and of swine influenza.

The method consists of opening the shell

with precaution, deposit a small quantity of virus upon the chorio-allantoid membrane, and then close the opening hermetically with paraffin. To obtain the culture a small portion of the membrane is lifted out when one knows, by experience, that the virus has attained the maximum multiplication, whereupon it is reinoculated into another egg and incubated.

(b) *Culture in vivo.* — For smallpox, ovine and avian variola, rabies, the cultivation of ultra-viruses is accomplished in appropriate institutes and laboratories.

In effect, is it not simply the method that provokes the eruption of vaccinal pustules on the skin of a heifer from superficial scarification or by injecting the "vaccine" into the common integument? And, is it not the same as the development of rabies virus in the nervous system after intracerebral inoculation, as the multiplication of sheep pox virus after subcutaneous insertion, or the development of bacteriophage in the young cells of susceptible microbes?

Conclusions.—Culture *in vitro* of the various ultra-viruses has been greatly improved in the course of the past few years and it has contributed immensely to all microbiology. The procedure is not only of theoretical interest but also promises to render precious service in the prophylaxis of contagions, as indicated by work already done in variola, yellow fever, influenza and foot and mouth disease.

In regard to antivariolic vaccinations (small pox) of the present time, cultures of the vaccinal virus are being substituted, more and more, for the vaccine collected from inoculated animals.

Pathogenic Action.—That which essentially characterizes the ultra-viruses and that conferring a clear individuality to them is not so much their physical, chemical and biological properties; not so much their filtering quality, invisibility and biotropism; but the pathogenic action which alone reveals their presence to the eyes of the observer.

The virulence is sometimes manifested by the appearance of a general, septicemic infection, sometimes by the formation of local processes in certain organs or apparatus, sometimes, and this is the most common, by an initial, precocious, temporary septicemia, preceding the specific localization (foot and mouth disease, hog cholera, rinderpest . . .). The lesions thus provoked, as Philibert has shown, present a truly particular character, affecting as they do the noble cells of the economy to the exclusion of all other reactions. In that rôle, viruses cause neither inflammation, suppuration, caseation nor extensive necrosis. All visible microbes actually understood produce alterations singularly different, alterations of inflammatory origin with more or less intense reaction of the connective tissue (congestion, exudation of fibrin, sanguinous serosity, diapedsis, phagocytosis).

Cells parasitized by an ultra-virus react in the form of a specific alteration properly appertaining to them; generally, proceses of lysis and cellular destruction (smallpox, sheep pox, herpes, rabies . . .). In some instances, on the contrary, there are phenomena of segmentation and of laryokenesis, which are manifested in a high degree in tumors caused by viruses (sarcoma Peyton-Rous, warts in man and animals). That is why the ultra-viruses manifested by these truly particular properties have been named "cytolytic" and "cytokinetic."

Cellular Affinities. — Borrel observed long ago the primitive alterations of epithelial cells due to the pathogenic action of ultra-viruses. He proposed the grouping of all diseases thus caused under the name of "epitheliases"—taking their affinity for epithelium as the type-character.

Levaditi shed light on the particular electivity of viruses in infected organisms. Taking as the basis the embryonic origin of tissues, he demonstrated the exquisite affinity of ultra-viruses for the nervous system, for the skin or for both of these tissues together. Thus was born the grouping of the *neurotrophic ectodermatoses* which has enjoyed attention in recent years.

The ultra-viruses likewise possess a high tropism for the young cells in the course of growth, of mitosis, and this explains their affinity for germinal cells (ovaries and testicles) and the troubling experiments of Burnet on contagious epithelioma of fowl

or of Levaditi on vaccina of rabbits. Burnet inoculated the virus of epithelioma into the axillary vein of a chicken and at the same time plucked some of its feathers. Small epitheliomatous tumors appeared on the skin but they were located exclusively at the level of the plucked region.

One may likewise signalize with Waldmann and his coworkers, the electivity of certain viruses for the lungs (pneumotrophic virus of influenza of man and swine, cough of Hoppegarten of the horse, infectious bronchitis of the ox . . .).

In résumé, the manifest affinity for the nervous system, for the skin, and for the germinal organs compared with a lesser affinity for the other apparatus (lungs in particular), appear to be the most troubling properties of ultra-viruses.

Ultra-Virus Saprophytes.—In the course of the last few years, the discovery of virus saprophytes marked an important date in the history of these elements. But the search for them is delicate. In effect, to find them it is almost necessary to render them pathogenic and discover susceptible species of animal (Hauduroy), or else disclose certain inapparent alterations that are able to provoke in the body they inhabit (cellular inclusions, hepatic and renal, due to an ultra-virus saprophyte of the dog).

Some ultra-virus saprophytes have been found in man, the monkey, the dog, the rabbit, the guinea pig, the mouse and several wild species. Laidlaw and Elford isolated them in the sewage of London, and d'Herelle in the sulphur springs of Challes-les-Bains.

Duthoit recently brought out an interesting contribution to the study of the epidemiology of these infections when he demonstrated that certain wild animals of South Africa are capable of harboring certain ultra-virus, saprophytes for them but pathogenic for other species of animals. Thus a virus of the gnu provokes a mortal disease of the ox—*snotseikie.* Perhaps, this is not an ultra-virus saprophyte in the strict sense of the term, but an inapparent infection.

Classification.—The varied properties of ultra-viruses have served as the basis of many classifications (those of Borrel, Levaditi, Philibert, Seifried, etc.). But to make up groupings that are homogenous and rational is a difficult task to accomplish. How can diseases be associated and classified judiciously that are as unlike as infectious anemia of the horse, the leucoses of fowl, rabies, grippe of the pig, Carré's disease (canine distemper) and the cough of Hoppegarten? Is it not permitted to believe in addition that certain filterable virus affections, identified in certain species of animals, have been ulteriorly rediscovered and catalogued under other names? Cannot one suppose, at least in regard to certain processes, that the plurality of the virus has dissociated in an unjustifiable manner, entities that are but variants of the same infection (fowl pest whose manifestations are about the same as those of Egypt, India, Newcastle, Corea, Philippines, etc. . . .) which seem to shed light perfectly on difficulties that have been a hindrance.

That is why we have thought of overcoming these obstacles and bring to the literature synthetic views as clear as possible and inspired, in this work, by the embryonic origin of tissues, the pathogenic action of the ultra-viruses, and above all the electivity they manifest in regard to the different parts of the organism infected.

A. Virus Naturally Pathogenic

I. *Visible and Filterable Virus* that can be cultivated on the usual media, includes only contagious pleuropneumonia of the ox and contagious agalactia.

II. *Cytotropic Virus,* or virus that can be cultivated only in the presence of living cells (animals, microbes, tissue cultures).

(a) ECTOTROPES

1. *Cytokinetics.*

Variola of the chicken, pigeon and canary.
Variola of the carp.
Epithelioma of the barbel.
Warts of the ox.
Papillamatoses (warts) of the dog and domestic rabbit.
Myxoma of the rabbit.
Sarcoma of Rous.
Endothelioma of Murray.
Avian leukoses.

2. *Cytolytics.*

a. Neurotropes

Rabies, infectious bulbar paralysis, and Borna disease.
Encephalitogenic viruses of the horse, ox, sheep, swine, and fox.
Infectious paralysis, pest, pseudo-

poliomyelitis, Jonesco's disease of the guinea pig.
Fowl paralysis of Marek.
Louping-ill.
Trembles.
Three-day disease.
b. Dermatropes
Variola (pox) of the horse, ox, pig, goat, and camel.
Contagious muco-pustular dermatitis.
Contagious vesicular stomatitis.
Foot and mouth disease.
Blue tongue.
Coital exanthema of the ox.
Vesicular exanthema of swine.
Gangrene of the limbs of rabbits.
Strangeway's disease of the hare.
Infectious ectromelia of the mouse.
c. Dermo-Neurotropes
Carré's disease (distemper) of the dog, fox, and mink.
Fowl pest of the chicken, duck and goose, and pseudo avian pests.
Hog cholera and East African swine fever.
Rinderpest.
Maggiora and Valenti's disease of the blackbird.
Kikuth and Gollute's disease of the canary.

3. *Mixed.*
Sheep pox (clavelée).
Carpono's disease of the ox.
Granular conjunctivitis of rabbits.

(b) ENDOTROPES.

1. With affinity for the respiratory tract.
Pleuropneumonia of goats.
Bronchitis and broncho-pneumonia of the ox.
Infectious bronchitis of sheep.
Cough of Hoppegarten of the horse.
Infectious laryngotracheitis of fowl.
Grippe of the pig (influenza).
Coryza of sheep.
Typhoid fever (influenza) of the horse.

2. With affinity for the digestive tract.
Infectious enteritis of cats (cat disease?).
Fever of the Valley of Rift.
Nairobi's disease.

(c) MESOTROPES (Affinity for blood and lymph).
Infectious anemia of the horse (swamp fever).
Pernicious anemia of the sheep and goat.
Pernicious anemia of dogs.
Avian leukoses.
Aoki's disease of the hare.
Equine pest.

(d) BACTERIOTROPES—bacteriophages.

III. *Unclassified Viruses.*
Strangles (influenza).
Dengue.
Periodic ophthalmia.
Psittacosis and virus of Sao Paulo.

B. Saphrophyte Viruses—Experimental Pathogens
Virus of the submaxillary glands of the guinea pig.
Noguchi's filterable virus of the guinea pig.
Non-pathogenic virus of mice.
Encephalitogenic virus of the dog and cat.
Acidolphilous inclusions of the renal cells of the sewer rat.

Origin of Ultra-viruses.—Ch. Nicolle's fine work entitled the "Destiny of Infectious Diseases" (page 211 and others) supports in an extremely brilliant manner, the microbic origin of the ultra-viruses and calls them inframicrobes. To him there is no distinct separation between the two, except the whole gamut of transition between the figured microbes and the invisible elements: Microbes not known to have filterable forms; bacteria possessing virulent filtrates which in turn become virulent germs (bacillus of Koch); and ultra-viruses the figured and visible state of which are ignored.

One can agree with Hauduroy that if ultra-viruses do have a microbic origin there is no experimental proof to that effect at this time and that the entire demonstration is yet to be made. The conception of Ch. Nicolle would enable one to clear up the mystery of secondary organisms (*germes de sortie*) and would enable one better to understand why the same ultra-virus nearly always bring about the multiplication of the same micro-organisms in the infected body, namely: The virus of scarlet fever and hemolytic streptococci; the virus of grippe and the bacillus of Pfeiffer; the virus of hog cholera and the *Salmonella suipestifer,* etc. With that conception the secondary infection would be but the visible form of the ultra-virus, an hypothesis formulated long ago by Lourens and Glasser in connection with hog cholera and the superimposed Salmonella.

Nature of Ultra-Viruses. — Numerous theories have tried to penetrate the intimate nature of ultra-viruses, as inorganic elements, as unorganized organic elements

(type diastases), as elements organic and organized having a special form of life (type *contagium vivum fluidum* applied by Beijernick to the virus of mosaic disease of tobacco), and as elements organic and organized in the microbian form.

Most of the authors believe, with Levaditi, that the ultra-viruses possess all of the character of the living cell; namely: Activity proper, faculty of adaptation, power of reproduction, and transmission in series of the morbid process. But objections have been frequently raised against that conception since the discovery of the first ultra-viruses. The living nature of rabies virus has been denied, and so has that of infectious anemia of the horses, etc. Parvulesco wrote in Roumania, some time ago, that the notion the living ultra-virus is untruthful and not entirely satisfying and that it is particularly opportune to consider, in particular, the virus of foot and mouth disease as "a non-living substance."

The announcement that an ultra-virus is crystalizable and has been crystalized, perfectly virulent, necessarily throws doubt on our conception of the living nature of these elements and tends, singularly, to modify our ideas on the living quality of other filterable viruses.

Stanley, in 1936, reported that he had isolated extracts from the plant of Turkish tobacco parasitized by the virus of mosaic disease—a "crystalized protein" having all the infecting properties of the primitive virus. The pathogenic action was constant even after repeated crystalizations. However, a pH strongly acid or alkaline (less than 1 and over 11), heating to a temperature of 80°, and slow digestion with pepsin, denatured the protein and made it lose its harmfulness. The isoelectric point of this protein was 3.2 and its molecular weight surpassed that of all known proteins.

The virulence of the crystal is considerable. A cubic centimeter of a solution containing 10 grams of crystaline protein conserved its infecting property. Finally, the serums of animals injected either with extract of the plant or with a solution of the crystal, precipitate identically in the presence of the specific antigen.

Wyckoff, in 1937, also succeeded in crystalizing the virus of mosaic tobacco disease by ultra-centrifugation and he isolated in the same manner the protein of infectious papillomatosis of rabbits. One milligram of this protein was capable of unleashing the disease in a million individuals.

The experiments, so daring and captivating, this revolutionary conception of the nature of ultra-viruses, are too new to permit one to paint a picture of their *ensemble*. They incite one, however, to be more prudent in our appreciations, and to be more severe with our judgments. They teach the fragility and instability of our knowledge of the ultra-viruses and for each one of us, a magistral and enlightening instruction.

[In an address before the American Association for the Advancement of Science, Prof. Ralph S. Lillie, of the University of Chicago, said: "Partial glimpses of the means through which life controls and arranges its raw materials are given in such life processes as of the genes, hormones, and cell secretions and of still-unidentified "organizer" substances that decide where and of what size and shape the various organs of an animal shall be. In the non-living world, approaches to the same kind of process are seen in the "self-reduplicative" activities of the ultraviruses and bacteriophage. These are now pretty generally acknowledged to be large but non-living protein molecules."

The place ultra-viruses occupy in the orthodox classification of matter into living and non-living things was presented in the following words at the same meeting of the A.A.A.S., by Dr. W. M. Stanley, of the Rockefeller Institute for Medical Research: "Virus molecules are now well established as non-living matter possessed of life-like characteristics. It is not necessary to look upon them as the lowest beginnings of what might turn into life, that is as pre-living matter as they may even represent the last stages (degeneration) of the reverse process. When an organism takes to the parasitic mode of living it loses things needed in independent life. Parasitic plants lose their leaves and insects their wings. In more advanced parasitism only organs needed to feed are retained. Worm parasites are examples. Ultra-viruses as parasites have lost their cytoplasm. They depend upon the host to furnish that part of the cell. Then the nuclear organization might go and leave only large, complex molecules of nucleo-protein that is capable of taking on material from the host and using it in self-multplication. That last stage is about what a disease-producing virus is. It may thus be either at the bottom of life on the way up or be at the top on the way down.

"Viruses treated with certain chemicals (hydrogen peroxide, formaldehyde, ultraviolet light) be-

come inactive and altered chemically and they still retain the chemical and serological properties which has immunizing value.

"Being intermediate in size and properties between living and non-living matter, the protein may represent a type of entity heretofore unrecognized. This means that a new class of matter neither living or non-living may be discovered.

"Because the protein has ability to reproduce itself under certain conditions, the understanding of the mechanism may throw light upon the way in which protoplasm, the stuff of life, grows".—Ed.]

A Peculiar Malady of Swine

Early in January an investigation was made of a malady affecting a pure-bred herd of Duroc swine consisting of approximately 150 hogs of various sizes and ages, ranging from shotes weighing 50 pounds to the herd boar weighing about 1000 pounds. Nearly all the swine were home-raised, although there had been a few additions. All were fed a slop feed made from the best grade of shorts obtainable. All had been given serum and virus in different lots at different times.

The first hog to develop the malady lived only a few days. The disease appeared in two or three hogs every week. Up to the time of the examination about 25 hogs had been affected, and some 10 or 15 of these had died. The herd boar had been affected, but had practically recovered at the time of the visit.

The swine on this farm were kept in lots, the number in each lot varying according to size, sex, and so on. The disease occurred in swine in three different lots, but did not occur in a fourth lot, in which there were some forty, bred gilts. Swine of all ages were affected.

Symptoms.—The first symptom observed in all cases was diarrhea. The fecal discharges were thin and watery, and contained varying quantities of blood. The temperature of the affected hogs varied from 104° to 106°F. There was almost complete inappetence and rapid shrinkage. In the cases which recovered the diarrhea gradually subsided and appetite returned, the disease running its course in from four to seven or eight days.

Lesions. — Only one shote, weighing about 60 pounds, was available for autopsy. This shote died the morning of January 10th, and was autopsied about 2 p.m. the same day. The lesions noted involved the gastric and cecal mucosa. There were areas of cheesy exudate attached to the mucosa of the large intestine. These lesions in gross were suggestive of coccidiosis, amebic infestation, or possibly paratyphoid infection. Microscopic examination of the involved intestine revealed some coccidia and possibly also some spirochetes.

Treatment.—The owner of the swine, assuming that he was dealing with cholera, had administered serum in some cases and serum and bacterin in others. When the serum and bacterin were administered as soon as the diarrhea became evident, the animal almost invariably recovered. In addition to the administration of biological products, alkaline treatment was suggested and carried out.

The chief puzzling factor in this syndrome was the high temperature. Coccidial or amebic infestation is not usually associated with a rise in temperature. Spirochetosis may be accompanied by high temperature, but not by as marked a rise as was observed in these hogs.

Another perplexing feature was the recovery of a large percentage of the infected hogs. The outstanding case in this respect was the herd boar, an animal weighing about 1000 pounds, which, although severely affected, made a complete recovery.

In recent months it has been demonstrated that Aujeszky's disease (pseudorabies) caused by a filterable virus is more or less prevalent in swine in this country; but according to the available literature, there is usually some nervous manifestation. There was no evidence of any nervous disorder in this lot of hogs. In spite of the fact that a large percentage of the animals recovered after receiving anti-hog cholera serum, a diagnosis of cholera does not appear to be warranted, for had the disease been cholera, nearly all the animals affected would have died.

I shall appreciate further information and particularly a probable diagnosis.—*E. L. D.*, Kansas.

Variation in Hatchability

Eggs of Single Comb White Leghorn Pullets[1]

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Introduction

The problem of hatchability is of great economic importance as well as considerable scientific interest. The poultryman would like to know how to cut down losses during incubation; the scientist would like to find out the causes of such losses and a solution for the problem.

The problems of incubation and hatchability have been of scientific interest to research workers for several decades, and though much progress has been made in uncovering various circumstances which cause fertile eggs to fail to hatch, the problem *still* remains one of major importance to the poultry raiser. The progression of scientific thought since the turn of the century has been from consideration of the external factors affecting incubation and hatchability to such internal factors as genetics and nutrition.

Three decades ago emphasis was placed on such factors as temperature, humidity, cooling and ventilation. Two decades ago the geneticist increased hatchability by methods of selection and breeding. Within the last decade the nutritionist has demonstrated the important part nutrition plays in hatchability. It should be remembered, however, that the problem of hatchability is one of extreme complexity and likely involves many factors, some of which may not now be recognized.

Thirty years ago poultrymen debated which was more important—breeding or feeding—in such matters as growth, production and hatchability. Twenty years ago the geneticist was able to materially increase growth, production and hatchability and decrease molt and broodiness by methods of selection and breeding. This he was able to do in the absence of scientific information on the nutritional requirements of chickens and using diets which today would no doubt appear woefully inadequate. However, a review of some of our recent nutritional research unquestionably brings to light the important part nutrition can play in increased growth, production and hatchability.

The age-old problem of feeding and breeding appears to be amplified to one of genetics and nutrition. Selection and breeding is a foundation upon which much of our poultry progress has been built and selection and breeding is unquestionably an important consideration today. Some of our nutritional studies appear to be complicated by genetic factors. In this way we can account for some of the inconclusive nutritional results obtained. It is our opinion that studies in hatchability and perhaps growth are basically influenced by genetic factors. It is our belief that some of our nutritional information needs clarification in the light of a better genetic background and, conversely, results in genetics will, no doubt, be better understood in a light of more complete nutritional information and control.

It is with this thought in mind that we instituted this study of the individual variation in hatchability. It was undertaken to consider the hatchability behavior of known stock under controlled conditions as measured by individual variation. We believe these data to be of sufficient interest to the nutritional worker to justify us in passing them on for whatever, if any, useful purpose they may serve.

The basis of this experiment was to secure single comb white Leghorn chicks from accredited sources, study their growth and progress from day old to maturity under controlled conditions. The conditions were to include a diet considered adequate and with special reference to vitamins A, B, D and G (complex) as demonstrated by bioassay. To trapnest, pedigree hatch and study the progeny of the individual pullets

[1] Received for publication, Aug. 7, 1937.

raised under such controlled conditions, with the object of determining any degree of variation in hatchability that might result from chickens reared under the conditions of this experiment was undertaken.

Conditions of the Experiment

1. a. *Chicks.*—This work was started in the spring of 1936 by the purchase of 100 day-old chicks—fifty from each of two nearby accredited sources. Each lot of chicks was maintained as a separate unit, designated as lots 1 and 2. The chicks were wing-banded and weighed when one day old; weekly weighings were continued for a period of twelve weeks, and monthly weighings thereafter.

b. *Brooding.*—The chicks were brooded for five weeks in an electrically heated and controlled battery brooder in a basement room of the laboratory. At five weeks of age the chicks were removed to brooder houses on the experimental farm.

c. *Feed and Feeding.*—The chicks were fed on a commercial feed* in pellet form from appropriate metal hoppers and fed *ad lib.* The feed and feeding systems were designated as A, B and C, and were as follows:

A. Baby chick mash pellets from day-old to 12 weeks.
B. Growing mash pellets from 12 weeks to 20 weeks.
C. Egg laying pellets from 20 weeks through the laying and breeding period.

The chicks (pullets and cockerels) were maintained on an exclusive diet of these three feeds.

The feeds were bio-assayed by this laboratory. The results are shown in Table I. The chemical analysis of the feeds is given in Table II.

d. *Water.*—Tap water was provided in suitable fountains, *ad lib.*

e. *Housing.*—At the expiration of five weeks each lot of chicks was removed to separate 8'x10' brooder houses on the experimental farm. These were without artificial heat. They were designed to serve later as laying and breeding units.

f. *Exercise and Confinement.*—The chicks were under absolute confinement at all times. For the first five weeks they were kept in battery brooders, thereafter in combination brooder and adult quarters.

2. a. *Pullets.*—When the chicks approached the laying stage (20 weeks), they were classified as layers and potential pullet breeders, and a change from a growing to a laying diet was made. Since there was no distinction between our layers and breeders (in diet and general management which were identical) these two phases, laying and breeding, are considered as one in this experiment.

b. *Egg Production.*—The pullets began laying when slightly under 26 weeks of age and by the first of the year (1937) all were well along in egg production. The pullets were trapnested and a record was kept of egg production and egg weights. A record of egg production will be found in Tables VI and IX.

c. *Cockerels.*—The cockerels were sold when 12 weeks of age, except that three cockerels—one as a breeder and two in reserve—were carried over from each lot of chicks. The cockerels were chosen without any knowledge, of course, as to their relationship to the pullets or of their genetic bearing on the experiment.

d. *Breeding Units.*—The breeding units consisted of 23 pullets and one cockerel and 16 pullets and one cockerel raised from chicks in lots 1 and 2 respectively. We considered lot 1 too large a number of pullets for one cockerel; however, on account of the genetic aspect of our experiment we believed it to be wiser to deal with but one cockerel, if possible, in each breeding unit.

e. *Feed and Feeding.*—The layers and breeders were fed feed "C", described elsewhere, from the 20th week through the laying and hatching season. The feed was made available to the pullets in suitable metal hoppers and in amounts to constitute *ad lib.* feeding. The pullets, like the chicks, were fed exclusively on the pellet feed referred to, with the exception that grit and oyster shell were provided in hoppers during the laying and breeding season.

f. *Water.*—Tap water was available *ad lib.*

g. *Housing.*—Each lot of pullet breeders was housed in an 8'x10' brooder house—the same quarters that served previously as a brooder house.

h. *Incubation.*—We chose the period from January 27 to March 15 as our 1937 hatching season. On January 27 the first eggs were reserved for incubation after they were recorded and weighed. A total of 590 eggs were reserved for incubation and nutritional studies. Of this number, 482 were set and the balance, 108, were reserved for nutritional studies. This does not include 41 eggs which were discarded because of abnormality, cracked, or laid on floor of pen. The eggs were reserved for 14, 12 and 12 days for the first, second and third hatches respectively before incubation. The eggs were stored at an average temperature of 50° F. and their position was changed daily.

The eggs were incubated in a forced draft, cabinet incubator and complete records were kept on temperature and humidity. The growth of embryo was observed on the 7th, 14th and 18th days. On the 18th day the eggs from each individual pullet were separated and placed in pedigree baskets. The chicks when hatched were weighed, wing-banded, recorded, and placed on the same dietary regime as the P_1 chicks.

i. *Methods.*—Except as noted, all methods were in accordance with scientific principles and practices of poultry husbandry.

j. *Mortality.*—The death loss from all causes up to the 9th and 12th weeks for the F_1 cockerels and pullets respectively (progeny of the hatchability experiment), was a total of 27 (8.7%) chicks.

* From Nutrena Mills, Incorporated.

3. a. *Egg Study.*—As the pullets came into egg production, six were chosen at random to furnish eggs for laboratory study as well as to provide data on hatchability. A report of these studies will be found in Tables VII and VIII.

b. *Liver Study.*—Of the original six hens chosen for egg and liver studies, one—No. 294—failed to provide any progeny for study. The others contributed four cockerels each with the exception of hen No. 412, which furnished two pullets. A report of these studies will be found in Table VII.

TABLE I. VITAMIN UNITS* PER 100gm. FEED

Vitamin	A	B	D	G
Units	U.S.P.	Sherman	U.S.P.	Sherman
Feed A	1,387	132	38	99
Feed B	2,033	.....	....	....
Feed C	1,568	132	59	99

*Assays were run at levels indicated. The reported unitage is the result of several assays of the feed during this experiment. Vitamin A, D, and G assays show the reported amounts for these vitamins to be very close to the critical level of the vitamin content of the feed. Vitamin B assays show the feed to have slightly higher amounts than reported.

TABLE II. CHEMICAL ANALYSIS (From feed tag)

	Protein not less than	Fat not less than	Carbo-hydrates N.F. Ex. not less than	Fiber not more than
Feed A	18.0	3.5	51.0	5.0
Feed B	17.0	5.0	53.0	6.0
Feed C	15.0	4.0	50.0	6.0

TABLE III. HATCHABILITY (First Hatch)

HEN NO.	EGGS SET	INFERTILE	DEAD GERM			DEAD IN SHELL	CHICKS HATCHED	% HATCHABILITY FERTILE EGGS
			7 day	14 day	18 day			
359	10	0	0	0	0	0	10	100.0
367	11	0	0	1	0	0	10	90.9
376	11	0	1	0	0	0	10	90.9
361	8	0	0	0	1	0	7	87.5
370	7	0	0	1	0	0	6	85.7
369	9	2	0	0	0	1	6	85.7
347	11	0	0	1	1	0	9	81.8
352	6	1	0	1	0	0	4	80.0
354	10	0	1	1	0	0	8	80.0
345	11	2	0	0	1	1	7	77.8
307	9	1	0	1	1	0	6	75.0
104	7	1	0	0	2	0	4	66.7
332	12	0	0	1	4	0	7	58.3
314	7	0	0	2	1	0	4	57.1
388	7	0	1	2	0	0	4	57.1
412	7	0	0	0	0	3	4	57.1
353	9	0	1	2	1	0	5	55.6
327	7	1	1	3	0	0	2	33.3
350	8	0	2	4	1	0	1	12.5
294	8	0	5	3	0	0	0	0.0
365	9	1	8	0	0	0	0	0.0
Total	184	9	20	23	13	5	114	65.1

TABLE IV. HATCHABILITY (Second Hatch)

HEN NO.	EGGS SET	INFERTILE	DEAD GERM			DEAD IN SHELL	CHICKS HATCHED	% HATCHABILITY FERTILE EGGS
			7 day	14 Day	18 Day			
354	9	1	0	0	0	0	8	100.0
359	6	0	0	0	0	0	6	100.0
327	9	0	0	0	1	0	8	88.9
347	9	1	0	0	1	0	7	87.5
332	8	0	0	0	1	0	7	87.5
367	6	0	1	0	0	0	5	83.3
376	6	0	1	0	0	0	5	83.3
370	6	1	0	0	1	0	4	80.0
369	8	0	0	0	0	2	6	75.0
314	9	0	0	2	1	0	6	66.7
361	6	0	1	0	0	1	4	66.7
353	8	1	1	1	1	0	4	57.1
345	8	1	0	1	2	0	4	57.1
104	6	0	0	2	1	0	3	50.0
325	6	0	2	0	1	0	3	50.0
350	9	0	2	1	2	0	4	44.4
412	6	1	0	0	2	1	2	40.0
388	6	0	0	3	1	0	2	33.3
357	7	0	2	1	2	0	2	28.6
307	7	1	0	0	5	0	1	16.7
294	6	2	3	1	0	0	0	0.0
365	7	2	1	2	2	0	0	0.0
Total	158	11	14	14	24	4	91	57.6

TABLE V. HATCHABILITY (Third Hatch)

HEN NO.	EGGS SET	INFERTILE	DEAD GERM			DEAD IN SHELL	CHICKS HATCHED	% HATCHABILITY FERTILE EGGS
			7 day	14 Day	18 Day			
332	8	0	0	0	0	0	8	100.0
354	8	0	0	0	0	0	8	100.0
353	5	0	0	0	0	0	5	100.0
361	5	0	0	0	0	0	5	100.0
345	7	2	0	0	0	0	5	100.0
367	7	0	0	0	0	0	7	100.0
350	4	0	0	0	0	0	4	100.0
388	10	1	0	0	1	0	8	88.9
370	9	0	0	0	1	0	8	88.9
347	7	0	1	0	0	0	6	85.7
359	7	0	0	0	1	0	6	85.7
376	6	0	1	0	0	0	5	83.3
104	6	0	1	0	0	0	5	83.3
327	8	0	0	1	0	1	6	75.0
369	9	1	0	0	1	1	6	75.0
365	7	0	0	2	0	0	5	71.4
307	7	1	0	1	2	0	3	50.0
325	5	1	2	0	0	0	2	50.0
412	6	0	1	0	2	0	3	50.0
357	4	1	0	1	1	0	1	33.3
294	5	0	3	2	0	0	0	0.0
Total	140	7	9	7	99	2	106	75.7

TABLE VI. TOTAL HATCHABILITY

HEN NO.	EGGS LAID	EGGS SET	INFERTILE	DEAD GERM			DEAD IN SHELL	CHICKS HATCHED	% HATCHABILITY FERTILE EGGS
				7 day	14 Day	18 Day			
359	27	23	0	0	0	1	0	22	95.6
354	27	27	1	1	1	0	0	24	92.3
367	27	24	0	1	1	0	0	22	91.7
376	27	23	0	3	0	0	0	20	87.0
370	28	22	1	0	1	2	0	18	85.7
347	32	27	1	1	1	2	0	22	84.6
361	25	19	0	1	0	1	1	16	84.2
352*	8	6	1	0	1	0	0	4	80.0
332	30	28	0	0	1	5	0	22	78.6
369	31	26	3	0	0	1	4	18	78.3
345	34	26	5	0	1	3	1	16	76.2
327	30	24	1	1	4	1	1	16	69.6
104	24	19	1	1	2	3	0	12	66.7
353	24	22	1	2	3	2	0	14	66.7
314**	27	23	1	1	5	2	0	14	63.6
388	16	16	0	0	4	2	0	10	62.5
307	27	23	3	0	2	8	0	10	50.0
412	25	19	1	1	0	4	4	9	50.0
325**	17	11	1	4	0	1	0	5	50.0
350	29	21	0	4	5	3	0	9	42.9
357**	21	11	1	2	2	3	0	3	30.0
365	26	23	3	9	4	2	0	5	25.0
294	23	19	2	11	6	0	0	0	0.0
Total	590	482	27	43	44	46	11	311	68.4

*One Hatch.
**Two Hatches.

TABLE VII. BLUE UNITS VITAMIN A[1]

From Hen No.	Hatch %	Blue Units Per Gm Yolk[2]	From Progeny of Hen No.	Blue Units Per Gm Liver[5]
294	0.0	10	294	0[3]
345	66.7	13	345	4
359	95.5	24	359	6
367	87.0	16	367	6
388	54.5	20	388	6
412	44.0	14	412	7[4]

[1] Method, Guilbert-Hart & McCoard-Clausen.
[2] Average of three trials.
[3] Progeny, none.
[4] Average of two livers.
[5] Average of four livers (6-8-10 weeks of age).
All calculations on a wet basis.

TABLE IX. FEED CONSUMPTION
(90 day period*)

Total number of fowl (23 pullets, 3 cockerels)	26
Total feed consumed (pounds)	765.5
Total eggs produced	1112
Average feed consumed per fowl per day (lb.)	327
Average feed consumed per pullet (lb.)	29.43
Average egg production	59.3%

* January 31 to April 30, 1937.

Discussion

In order to bring out whatever, if any, influence genetics or the influence of the individual hen, might exert on the problem of hatchability, it was our endeavor to control all other factors except the hen, herself, or the cockerel which headed the pen.

The chicks purchased in the spring of 1936 were from two nearby sources and while each lot of chicks was handled as an individual unit, the general conditions under which they were handled were identical with the one exception of vitamin intake. The chicks in lot 2, not reported in this study, were on a vitamin intake approximately 10% lower than those in lot 1 which forms the basis of this report. At the conclusion of the second hatch it was decided to discontinue further study on the chickens involved in lot 2 and concentrate our efforts upon but one group of chickens.

In passing it is interesting to relate that the pullets in lot 2 varied in hatchability from 10% to 100%, on data tabulated at the end of the second hatch.

TABLE VIII. SUMMARY OF EGG STUDIES

Hen No.	% Hatch	Eggs Laid[1]	Egg Weight (gm)	Shell Weight (gm)	% Moisture	Units B_1 Gm. of Egg Yolk[2]	Average Blue Units A per Gm.[3]
294	0.0	23	297.0	36.5	77.9	2.86 I.	10
345	76.2	34	323.0	44.0	76.9	*	13
359	95.6	27	271.0	33.5	77.2	*	24
367	91.7	27	295.5	38.5	77.8	*	16
388	63.6	27	290.5	40.0	78.0	*	20
412	50.0	25	300.0	40.0	76.5	3.24 I.	14

[1] From January 27 to March 15.
[2] Bio-assay (method, Shultz & Knott).
[3] Methods—McCoard & Clausen and Guilbert & Hart (av. 5 eggs).
* Less than 2.0 International Units per gram.

It will be observed that this experiment was divided into two phases: (1) the period extending from the spring of 1936 to January, 1937, during which time the original chicks were grown and maintained under controlled conditions. This phase served mainly to standardize the nutritional equilibrium of the pullets. (2) The period extending from January, 1937, to May, 1937. This phase is concerned chiefly with a study of the nutritional quality and hatchability of the eggs laid by the pullets.

It is obvious that we had no knowledge of the nutritional status of the chicks purchased at the start of these experiments. However, a study of Table I will show that we do have a knowledge of the nutritional intake of the chicks from hatching through the first year's breeding season.

In recent years a great deal of study has been made on the nutritional requirements of poultry, most of which has brought to attention the important part nutrition plays in such factors as growth, production, reproduction and livability in general. Although a great deal of this study has revolved around the effects of various levels of vitamin intake, the levels of intake for adequate, or optimal, results are not well defined in regard to vitamin intake in relation to hatchability.

Whether or not our level of vitamin intake is adequate for such factors as growth and hatchability can best be determined by a study of the results obtained. It will be observed that our vitamin intake compares favorably with the requirements recommended by various authorities for maximum hatchability.

In Table II is shown the chemical analysis of the feeds used in this experiment. Though these analyses are taken from the feed tags, they follow very closely the analyses made in this laboratory.*

Further examination of the feeds used in these studies prove them to be of high quality and not lacking in any nutritional considerations in light of our present knowledge of poultry nutrition.

A study of Tables III, IV, and V shows the hatching record of the individual pullets for the first, second and third hatches respectively whereas in Table VI is compiled the total hatching record of each pullet.

In order to standardize the genetics we chose to use one male heading our pen of 23 females and, although this may be considered too heavy a responsibility for one cockerel, it will be observed that only 27 of a total of 482 eggs incubated proved infertile —an average of 94.4% fertility.

A further study of Table VI will show that the pullets averaged 54.4% egg production during the period reserved for these studies. Under the conditions of the experiment together with the rigors of our climate, this egg production record could be considered good. The total average hatchability of 68.4% of fertile eggs incubated we consider relatively high under the conditions of this experiment. It will be observed that pullet No. 359 hatched 22 chicks out of a total of 23 eggs or an average of 95.6%; No. 365 hatched but five chicks out of a total of 23 eggs, or 21.7%; and pullet No. 294, with a total of 17 fertile eggs incubated, gave zero hatchability. Under the conditions of this experiment this was a wide variation in the percentage of chicks hatched from fertile eggs.

We regret that such a relatively large percentage of eggs was reserved for nutritional studies in the laboratory. We now would have preferred to place more emphasis on increasing the number of eggs set or extending the study over four or more hatches. The number of fertile eggs set are too few, perhaps, upon which to form any very definite conclusion as to the cause underlying such extreme variation in hatchability. The two most likely possibilities of such variation are:

1. The requirements of individual chickens for various nutritional factors concerned with hatchability may vary considerably. These requirements may have been met in our diet in the case of our pullet which gave us our best hatching record while in the case of pullets which gave us our poorest hatching records these requirements may have been deficient.

2. There is a major genetic factor concerned with hatchability.

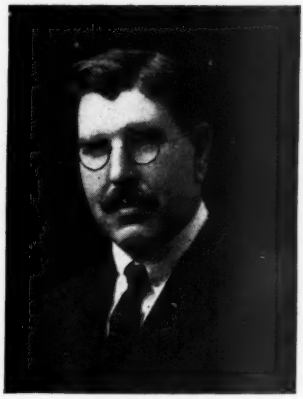
* Patton Biological Laboratories.

Some workers seem to infer that high egg records are synonymous with high hatchability. Our best pullet, No. 359, with a hatchability record of 95.6% laid 27 eggs and pullet No. 365 with a hatchability record of 21.7% laid 26 eggs during our test period.

In Table VII will be found a record of blue units (Vitamin A) of the yolk of eggs laid by six pullets chosen at the end of the first hatch and the livers of some of their progeny.

Comment

This study should emphasize the necessity of using stock of known hatching potentiality in connection with nutritional studies involving hatchability.



Dr. W. B. Craig

Wm. B. Craig was born in Ayrshire, Scotland, in 1868; graduated from the Ontario Veterinary College in 1889 and from the Medical College of Indiana (now the University of Indiana School of Medicine) in 1893. He began veterinary practice in Indianapolis immediately thereafter. He was dean of the Indiana Veterinary College from 1900 to 1924. For many years, and particularly since the close of the Indiana Veterinary College, Doctor Craig had a large consultation practice in Indiana and surrounding states. His services were always in great demand at Indiana and various other state meetings to handle the surgical clinic. He had been secretary-treasurer of the Indiana Veterinary Medical Association for a dozen years and long a leader in all matters concerning veterinary medicine in Indiana. He was taken sick last November; at first he improved steadily, but later developed a thrombosis in the region of the iliac bifurcation which necessitated the amputation of his right leg. Following the operation he declined steadily, dying a month later—February 16, 1938. He is survived by his widow, two daughters, a son, and a grandson.

1937 Dog Statistics

Bench shows increased from 302 in 1936 to 317 in 1937.

Cockers registered about 14,000 dogs in 1937, taking first place. This, however, is considerably below the alltime high made by the German shepherd in 1926—21,500.

The AKC increased its membership from 193 to 211 clubs, an alltime high.

America's largest show, the M&E, was captured by an American bred dog, the English setter Ch. Sturdy Max.—*Dog World.*

Veterinary Education in Colombia

The School of Veterinary Medicine of the National University of the Republic of Colombia was founded in 1921. It is located in the capital, Bogota, and has 18 veterinarians on the faculty. The graduating class (November, 1937) numbered 24. The course of instruction includes: First year, comparative anatomy, applied botany, embryology, entomology, medical physics, animal genetics, histology, animal management and biological chemistry; second year, comparative anatomy, bacteriology, feeds and feeding, pharmacy, veterinary physiology, milk inspection, general pathology and parasitology; third year, pathological anatomy, general surgery, general clinics, animal conformation, medical pathology, surgical pathology, lameness, therapeutics and special zootechnics; fourth year, poultry husbandry and diseases of birds, clinical medicine, clinical surgery, rural economics, infectious diseases, veterinary hygiene, animal husbandry, food inspection, diagnostic laboratory, veterinary jurisprudence and obstetrics.

Book Reviews

Diseases and Surgery of the Dog by Raymond J. Garbutt, D.V.S. Chief Veterinarian and Consultant of the Hospital of the A.S.P.C.A. 320 pages; 89 illustrated pages. Cloth. Price $3.50. Orange Judd Publishing Co., New York.

According to the publishers' announcement this work "is intended as an every day reference book for the dog fancier whether he keeps a single dog or operates a kennel." The author explains in the preface that "extreme simplification has been sought in every instance and elementary terms used wherever possible . . . and because transfusions and infusions are playing an increasingly important part in operative treatment, detailed technique has been given."

The contents are alphabetically arranged after the style of Sewell, Cousens, Black, and Judy. Many books have been published in the past the chief aim of which was to aid the layman in the care of dogs in sickness and in health. They have been for the most part confined to the use of "simple" home remedies and to emergency measures when professional services are unobtainable. Diseases and Surgery of the Dog, as its title implies, goes far beyond that function. It delves deeply into the realms of surgery, the dangers of which are all too obvious to the professional mind.

To devote the amount of space to surgical conditions, dislocations, fractures, etc., opens up new fields for the inexperienced to experiment in, at the expense of the dog patient and the veterinarian. Some of the text is addressed to the veterinarian as for example the types of anesthetics to be employed, the recommendation of a purse string suture in "prolapse of the anus" and, I would prefer to believe, the many pages on dislocations and the reduction of fractures, which are included for the "interest" of the dog owner.

Distemper is covered by six pages. Under treatment, Dr. Garbutt states: "No specific treatment has yet been found for distemper." He suggests therapy such as blood transfusions, physiological salt solution with glucose, given subcutaneously, intravenously and intraperitoneally, etc., which flatters the lay reader and should help convince the amateur, who has a flare for hypodermic syringes, that there is no need for skilled scientific services when the procedure is as "simple" as all this. The author, however, closes with the good advice "for a permanent prevention against distemper and the use of serum, see your veterinarian."

Eleven pages on feeding, giving sample diets for various breeds at different ages, contribute nothing new to canine nutrition and if such a thing is possible add to the confusion already existing. As proper nutrition is the best prevention against disease it is unfortunate that, for the education of the dog owner, a brief discussion of the relative merits of foodstuffs, has not been given.

Drugs and Preparations list thirty-one, eight of which are proprietary. Frequent recommendations for the use of some commercial preparation are strewn here and there throughout the text.

Francis Bacon, in his day, took all knowledge for his province. With the development of science—which Oliver Wendell Holmes defined as the topography of ignorance—men have become less bold in their excursions into diverse branches of learning. No man any longer essays to encompass the entire field of medical knowledge. Surgery, too, has become so broad that no one man's knowledge extends completely into its numerous ramifications. In this weakness lies the fundamental defect of this book. It is hoped that the author will, at some future date, publish at least in synopsis form, a work on the management of fractures, dislocations and sprains for readers whose training equips them to make use of such knowledge.

Perhaps the most impressive feature of this volume is the excellent illustrations. Those on femoral fractures (which have already appeared in the author's contributions to Lederle's Veterinary Bulletin) represent Doctor Garbutt's development of "zoo-osteonatry" (animal bone surgery).

The publishers are to be congratulated for their splendid choice of type and paper used in this book.—*H. J. Mostyn.*

Animal Nutrition. By Leonard A. Maynard, Professor of Animal Nutrition, Cornell University. Cloth. 483 pages. McGraw-Hill Book Co., New York. Price $4.00.

The purpose of this book is to present the principles of nutrition and their application in feeding practice. The early chapters provide a review of the essentials of nutritional chemistry and physiology. In the discussion of growth, lactation, and other body functions particular attention is given to the nutritive requirements of the various species of farm animals. No detailed feeding formula is given for individual species, as, according to the author, "feeding practices which differ for the various species lie outside of the scope of this book". The major purpose of this work is to teach how the facts of nutrition are being learned experimentally, and how they find application in practice.

This is the first edition and contains the newer knowledge up to the completion of the manuscript in the summer of 1937. The author has felt the need of a textbook that would correlate the work that has been contributed to the principles of animal nutrition, and the material presented represents a selection garnered from 20 years of teaching this subject.

He has avoided the usual dogmatic style of presentation so often found in the field of nutritional writings. Recent experiments are reported without prejudice and with a realization that today's new discoveries will undoubtedly bear modification in some not-far-off tomorrow. An extensive bibliography furnishes the student opportunity for collateral reading on the various topics discussed.

To illustrate how carefully the author presents a subject that is in dispute and cannot be set forth in any degree of finality: "There is no basis at the present time for making any statement as to whether muscular activity calls for an increased intake of any of the vitamins. The recent evidence that vitamin B may be concerned in carbohydrate metabolism is suggestive only. Practically nothing is known regarding the vitamin requirements of the horse for any purpose."—*H. J. Mostyn.*

Textbook of Experimental Surgery. By J. Markowitz, M.B., Ph.D., M.S., Research Associate Department of Physiology; formerly Assistant in Division of Experimental Surgery and Pathology, Mayo Foundation, Rochester, Minn. Cloth bound; 527 pages; profusely illustrated. Price $7.00. William Wood & Company, Baltimore.

More often than for any other text, veterinarians ask for a good work on veterinary surgery. There is none in English new enough to suit them. Markovitz' contribution will go a long way to meet this oft-expressed need, and do it in a highly satisfactory manner. Veterinarians will not need other assurance of its excellence than the statement, "Much, perhaps most, of the technic described is that in use at the Institute of Experimental Medicine of the Mayo Foundation", for they have seen, at A. V. M. A. clinics, demonstrations by Carl F. Schlotthauer and by F. C. Mann, to whom the work is dedicated, of the type of surgery done in that institution.

Experimental surgery is of necessity animal surgery, and surely half of this text deals with veterinary surgical operations or operations closely analogous to those veterinarians are called upon to perform. To this reviewer, this text seems simply indispensable to the veterinarian, particularly the practitioner that includes among his patients the ordinary animal pets, who desires to do creditable surgical work in these days of improving surgical technic.

* * * *

The Hounds of Hastings; the Welfare of Animals in a Small Town. By Marion Soetemon (Mrs. Arthur Edwin) Krows. No. 7 of a series of Bulletins of Social Legislation on the Henry Bergh Foundation for the Promotion of Humane Education, edited by Samuel McCune Lindsay. Foreword by Sydney Haines Coleman, President of The American Humane Association, and Executive Vice-President of The American Society for the Prevention of Cruelty of Animals. Cloth bound; 214 pages. Published by Columbia University Press, Columbia University, New York City. Price $1.90.

This book is a story of her experiences, almost a diary of the author, who 15 years ago moved from New York City to a suburb in the metropolitan area and because of her compassion for animals began, single-handed, an effort to relieve the suffering of animals in her community. Kin-

dred spirits in turn joined her; an S.P.C.A. was organized which was later incorporated and merged with others in West Chester County, New York. Mrs. Krows grew in wisdom and in resourcefulness with her work. Always sincere, she was nevertheless practical to canniness. At heart an anti-vivisectionist, she would not align her organization with that group because it would alienate valued support from her anti-cruelty crusade; with as much compassion for vermin as for dogs, cats, squirrels, or waterfowl, she eschewed the protection of pests because it would have been unpopular; without financial backing sufficient to employ veterinarians, and without the most rudimentary training in veterinary medicine herself, she nevertheless hesitated not to decree the life or death sentence on any sick or injured animal; or if the former to consign it to unskilled treatment, regardless of the unnecessary suffering that might entail. The author possesses a flare for newspaper publicity that is little short of genius, and no part of the work of her local S.P.C.A. was given more thought or more carefully planned throughout the year than newspaper publicity. On one occasion a sum equivalent to the entire income of the society for several months was expended in purchasing a team of horses that belonged to the village street department (when that department was motorized) that they might be retired to a life of rest in good pastures. There is no suggestion that the animals were unserviceable or likely to be subjected to cruelty and one infers the whole transaction was engineered for the whale of a newspaper story it made.

"Hounds of Hastings" is a manual of do's and don'ts for any individual or group that embarks or wants to embark on a prevention-of-cruelty-to-animals crusade. Because veterinarians stand first among all groups contributing to the relief of suffering in animals this work will be read by them with interest, if not always with approval. It is a good story well told.

Winner of Chappel Award

Mrs. George Bethune Adams, 88, for "her unremitting work of day and night service to the relief of all animals, especially dogs; her courage and high sense of devotion to duty coupled with her continued and prolonged efforts toward a better understanding between dogs and their owners and the example she has set for others who work so that man's duty to all domestic animals may in some better degree be met" was awarded the 1937 Chappel Award for distinguished service to dogdom.

For more than a score of years Mrs. Adams served as Manager and Resident Director of the Ellin Prince Speyer Hospital.

* * * *

Resolution Adopted by the U. S. Live Stock Sanitary Association

WHEREAS, Trichinosis in swine is considered of vital importance to the health of the public and at the same time it is of vital importance to the agricultural interests of the nation because of the possibility of jeopardizing the interests of the American swine producer and lessening the use of wholesome pork and pork products; and

WHEREAS, The control of trichinosis represents a responsibility of state live stock sanitary officials from the standpoint of protecting the health of live stock, and of public health officials from the standpoint of protecting the health of the people, and it also represents a dual responsibility of these agents for maintaining sanitary supervision of commercial hog feeding in territory under their respective jurisdictions; and

WHEREAS, It is known that the feeding of raw garbage is a medium through which trichinosis is conveyed to the highest percentage of infested animals; and

WHEREAS, Any systematic approach to the subject should avoid misleading or alarming publicity, which can at best but have the effect of lessening the confidence of the public in pork and pork products;

BE IT RESOLVED, That this association acknowledges a responsibility for co-operating with the officials concerned to the end that a program both scientific and practical be inaugurated for protecting swine from infestation with trichinosis; and

BE IT FURTHER RESOLVED, That it urges its members to co-operate with public health officials in carrying out their immediate responsibility in the control of known sources of infestation; and

BE IT STILL FURTHER RESOLVED, That they urge caution in the publicity aspects of any adopted program.